November 18, 1926
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The Civil Engineer in Industry - III

Open Foundation Plant and Methods on Manhattan Island

Staff Report on
Municipal Improvements Convention

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FRANK C. WIGHT
Editor

Volume 97 NEW YORK, NOVEMBER 18, 1926 Number 21

Chicago's Canal at the Bar

DOWN in Washington what ought to be one of the final chapters in the famous Chicago drainage canal case is being written. As special master for the United States Supreme Court Charles Evan Hughes is hearing the suit of a number of the states against the Sanitary District of Chicago. The Supreme Court was particularly happy in its selection of the master, for Mr. Hughes not only has the judicial background which is necessary to a proper appraisal of the law in the case, but as Secretary of State he became intimate with the international complications which lie hidden behind any decision the court will make. Chicago has repeatedly been rebuked by court and federal department for the extent of the diversion which is being made through the canal, but these rebukes have not had complete judicial authorization. In the case now being presented all of the domestic ramifications should be explored and a decision reached that is beyond controversy. No satisfactory adjustment of the Niagara and St. Lawrence waters can be made until the position of Chicago is definitely established. That is the commanding reason why a final court opinion is necessary, not because of the clamor arising from the Western lake states, for that would become mostly legalistic argument if perchance there should come a succession of rainy seasons in the northwest and the Great Lakes started to fill up toward some of their earlier levels.

Large-Scale and Model Testing

ONE reason for the preference which engineers have always accorded and perhaps always will accord large-scale tests as against model tests is represented in the preliminary results of the work on the Stevenson Creek experimental arch dam, briefly noted in this issue. The deflection and strain measurements were quite uniform and consistent, the dam proving itself a satisfactory test object; this lends weight to the measurements. From the plotted deflections it is seen that the upper zone of the dam deflected *upstream* along its outer quarters. This is contrary to all expectations, from theory or model tests. Possibly the upstream deflection indicates a buckling tendency of the upper elements of the dam, which are very long and slender columns, considered horizontally. Such buckling in turn may be connected with slight variations of form of the arch, too small to be noticeable during construction or in the subsequent inspection (the report says that the dam was accurate in shape and dimensions) but nevertheless of sufficient influence to determine the distortion. Whatever its explanation, the anomalous deflection shows that the behavior of arch dams is more complex than had been thought. Thus the full-size experiment has brought out something not revealed by tests on a laboratory scale. Quite the same thing can be said of all large-scale testing, for rarely has such work failed to develop features of behavior that had not been known or duly appreciated before. It is due to an instinctive perception of this truth that the popular mind as well as the engineer's mind finds a very decided assurance of reliability in a large-scale test, not given by small-scale testing even of the most precise kind. Were it not for its usually prohibitive cost, large-scale testing would therefore today occupy a position perhaps almost as vital as that which it held in the days of Telford and Hodgkinson. But cost, it happens, is so controlling an item that if all our engineering knowledge had to await verification by large-scale tests, our advance might be slowed up by the translation of decades into centuries.

No Dust On This City Plan

A NOTABLE exception to the rule that most city planning reports made by consultants are filed away to gather dust and be forgotten is afforded by experience at Wichita, Kan., as noted in our report on the convention of the American Society of Municipal Improvements elsewhere in this issue. In five years, says the city engineer of Wichita, much has been done to carry out the plan. He did not say, but it was evident to those who heard his paper, that carrying out the plan at Wichita is largely due to his own activities, as member and secretary of the city planning commission. He assumes that the plan was made to be worked to. He not only carries the city authorities with him in this assumption but the people also, notably property-owners and other citizens whose co-operation, even to the extent of personal sacrifice, is necessary. More such city engineers are needed. Here and there and now and then a city engineer is a leader. Usually he lets himself remain what city officials and the public are too prone to think—if the public thinks at all—that he is at most a sort of technical hired man.

A New Epoch

EXCEPTIONALLY significant news was reported last week from Washington, in the statement that two new reclamation projects are to be built by the government. The Secretary of the Interior has decided that these projects, Owyhee and Vale, though very costly, will probably return their cost to the reclamation fund. As qualified by the word "probably" the statement has a half-ironic effect, in view of the fact that the existing projects have not returned their cost, that they were read into bankruptcy less than four years ago, and that Congress reorganized them last year by donating to the landholders some twenty odd million dollars; yet it is very evidently a sincere statement of belief, as well as one of hope in the beneficent effects of better settlement and development methods than were applied

in the past. At all events with the decision to build these two projects the nation enters a new epoch in Western development. Federal reclamation is once more on trial, but under new conditions—on an economic basis never before thought possible—and at a time when the government's re-entry into the field appeared utterly beyond the bounds of probability. The renewed federal adventure seems fated to kill off the remaining vestige of private irrigation enterprise in all but the most southern regions of the country. Were the resumption of work coupled with the introduction of a genuinely sound financial system the case would be hopeful rather than otherwise. But that is a phase of the matter which Congress never has undertaken to modernize. The essential hope of the coming epoch of reclamation lies in an early reform of the financial relations between landholder and government.

Gigantic Bridge Brought Nearer

WITH the call for bids on the first instalment of bonds of the Port of New York Authority for a Hudson River bridge, a dream of many decades is brought measurably within reach. Engineers as well as other planners have concerned themselves with the problem of a fixed crossing of the river to replace the ferries, so far without result. Legal, financial and physical difficulties of tremendous magnitude stood in the way. A span of some 3,700 ft. and an investment of $50,000,000 are involved, with the further condition that the investment must be self-sustaining, and, if practicable, self-amortizing. All the difficulties, however, are in a fair way to being surmounted: the legal difficulties by the expedient of utilizing the Port of New York Authority, the financial difficulties by the state contributions begun at the last sessions of the New Jersey and New York Legislatures and by the present call for bids, which may be expected to be as successful as the financing of the two Arthur Kill bridges by the same body early this year. The event is even more significant, however, in its relation to the longstanding technical problem of bridging the Hudson. It signalizes the final defeat of the city concentration idea that has long been cultivated and championed by various interests in New York, engineering as well as commercial. New York is to be permitted to spread over the open spaces to the west. This is likely to be not a case of city extension so much as of city dispersal. The densely aggregated core of population which now constitutes that city has long been dammed away from its naturally destined outlying zones, and once a traffic channel of adequate volume is created to the westward this spread is bound to occur. The bottled-up city will relieve itself as surprisingly as did the densely packed medieval cities when changing epochs brought about the leveling of their ramparts.

Cellar Digging as a Science

FOUNDATION excavation methods especially in the larger cities are constantly changing. Increased traffic, both vehicle and pedestrian, shorter time allowances for completing the foundation, modern equipment, cramped working spaces, more careful underpinning operations, and a pride in the appearance of construction plant structures, all of minor concern a decade ago, are some of the present conditions that are causing these changes. They are imposing new obligations upon the foundation contractor. That these obligations are being variously accepted may be seen in any of the larger cities. The article this week on open cut foundation work describes prevailing practices in New York and is the result of a study of some 25 jobs under way during the past summer. The jobs were chosen at random so that contrasts between methods, good, bad and doubtful, were often evident. Some of these deserve mention. Machine operations were outstanding; the pick and shovel gang was found only on underpinning work. Modern equipment needs better care than did the old slip, fresno, and hand-operated pump. In most cases it is receiving it but jobs were found where electric motors, gas engines and compressors were being maltreated through carelessness and neglect. Plant structures such as fences, temporary sidewalks, guard rails and sidewalk arcades and sheeting to hold adjacent property have reached an especially advanced stage of perfection. A pleasing and neat appearance also is becoming the rule and such structures, built safely, create confidence on the part of the public. The few jobs whose structures invited disaster and presented a slipshod appearance were a dismal contrast. There is little excuse for such methods in these times of traffic congestion when the protection and convenience of the public are of major import on every job. On most of the foundation sites the arrangement of the equipment showed evidence of careful planning. On others the evidence was not so convincing. These several examples indicate that some few contractors are still thinking of present jobs in terms of old methods. From conditions now existing in the foundation excavation field many new obligations have evolved. A majority of the contractors have assumed them. The rest must do likewise. In addition all should realize that such obligations have not yet reached a saturation point but that they will continue to multiply.

Liberalizing the Engineering School

ENGINEERING education is comparatively young. Rensselaer Polytechnic Institute two years ago celebrated the centenary of the first conscious effort to teach how to do things in protest against the historic method of teaching what should be known. And it is at least fifty years since the great engineering schools of today started out intentionally to make engineers. But in the great process of education the teaching of engineering has hardly reached maturity, and neither teachers nor taught are sure that the methods used are the best for the desired ends. One thing, though, is becoming increasingly clear, and that is that the ends sought are many and diverse, and that the problem that is posed is not merely how to make an engineer. Engineering education today has to decide whether it wants to produce in the individual one of many kinds of engineers, or to fit the individual so he can later so decide, or even to submit the individual to such a régime as will enable him to apply an engineering mode of thought to activities not ordinarily thought to be concerned with engineering.

With so diverse a product it is not to be wondered that there is some dissatisfaction with the process. What suits one demand may be quite unsuitable for another. A system of instruction that turns out an excellent bridge designer may fail, nay probably will fail, to produce a general manager of an industry. And

yet the college neither from the wishes of its matriculates nor from the practices of its graduates can tell into which activity the individual will go. He comes to them as a rule merely with the request that he be made an engineer.

In consequence of this uncertainty of post-college endeavor we hear constantly from the graduate, the man who has had to single out for a life work one of the many specialties for which he was trained, the cry that the young man contemplating engineering as a career should be taught only the fundamentals, on the assumption that it is a fairly simple matter to single out those fundamentals and so to give instruction in them that the graduate will readily turn to any field he chooses, soundly based for further learning in that field and unincumbered with needless knowledge. And besides this the widening demands of business and politics are calling for the engineer, provided he can slough off some of his too great rigidity of thought and turn his mind into the more flexible bounds of economic and human relations.

The educators see the problem, but unlike most of their critics they see too its difficulties. The fundamentals are not easy to define and less easy to delimit. A firm grounding in the sciences after all does not make an engineer; he has to know something of their application. Culture and a wide interest, which the engineer may need, can possibly be inculcated by courses in the so-called humanities, but time is fleeting, especially to the boy who has limited capital and the urge to active work. And so the engineering schools, in response to the majority demand, ground the elementals in their students in the first two years, intensify the specialties in the last two and fit in as best they may in the limited time left the cultural superstructure.

In spite of much current belief to the contrary, the process has been successful in making engineers. It has produced the men who build our bridges, design our power plants and otherwise constantly make more livable this world of ours. It has not to be sure produced many great artists or politicians, but such a lack is probably due more to congenital deficiency than to collegiate training. It has even produced great industrial leaders and masters of business. Whether more of these latter can be produced by a different system of training whereby the basic principles of engineering are grafted on a study of the arts and human sciences is a fair question. And whether this same sort of liberalized training will lay the basis for an engineering career of wider usefulness and greater reward than the usual one is a further question that remains to be answered.

It is interesting to note that one of our oldest institutions of learning is starting out to attempt an answer to these questions. Princeton University has hitherto had a small engineering department, which up to within a year or two was run on conventional lines. It is now starting on a new theory. It will offer courses in engineering, leading to a bachelor degree, in which intense specialization will not be attempted, in which the so-called fundamentals will be stressed and the main features, at least, of each branch of engineering traversed, and at the same time it will endeavor to introduce the student to the rich fields of thought that the colleges of arts and sciences afford. In other words, an engineering school is set down in an atmosphere of culture, in the hope that its students while getting enough engineering either to indicate to them the engineering mode of thought or to encourage them to more detailed engineering study will at the same time absorb the broader view that engineers are thought to lack.

Such a course is, as has been said, experimental. It has the virtue of according with the ideas of a great many men who have favored liberalizing the engineering training. Some of these men are engineers who have themselves felt the need of a broader view and some are business men or executives who sense, or think they sense, in the engineer a lack of a something they think such a course will provide. It is desirable that somewhere in the country there be afforded an opportunity to test out the theory that these men hold. There is enough doubt as to just how the best type of engineering mind can be developed that every worthy experiment has its place.

Wanted—Some Jeremiahs

PSYCHOLOGISTS seem to be agreed that most children can be spurred to effort by praise. They like to be told how good they are and work harder striving for expected perfection than under the lash of merited criticism. A whole school of business philosophy has been built up on the same principle. Certain distinguished business leaders are its leading exponents and their optimistic forecasts have been so regularly confirmed that many of their devoted disciples have come to confuse cause with effect.

The philosophy has especially penetrated into the as yet experimental practice of the trade association. Nothing, appears to be the motto of many of these associations, is good or bad but thinking makes it so. Not only do they tell the whole world how good is the product they have to sell, which is their legitimate function, but even in their own counsels a similar pleasant optimism prevails. The Association of Tin Pail Manufacturers meets in April and listens to some of the most prominent pail users in the country tell not only how superior is tin as a material for pails but how utterly hopeless it is to expect papier maché to make a usable receptacle. And in August the Organized Papier Maché Pail Makers get together to hear equally prominent pail users wonder how it is possible that any sane man could use tin for an ice box pan, much less a pail. And both groups go home happy in the assurance that success is theirs not because they are going to make better pails but because the competing pails are going to be put out of business as soon as the truths reported to them at their convention get out to the user.

Maybe this is good child psychology; certainly it seems childish enough when applied to adults. Some day a wise trade association is going to retain a Jeremiah, some user of their product who is experienced and courageous, who will indulge in a few "Woe unto ye's," who will tell them to their face and with the dangers of discussion before him not how defective their competitor's product is but how far theirs fails of perfection. The meeting can be held behind closed doors, if need be, and reporters excluded, but the members will go home with resolves to turn defects into virtues instead of as now, with convictions that the fight is won because of the competitor's insufficiency. Knowledge of the enemy's weakness is an invaluable factor in military strategy, but it is a good thing to know just how one's own forces are disposed.

Open Foundation Plant and Methods On Manhattan Island

Crowded Streets, Close Buildings, Irregular Subsurface Conditions, Earth and Rock Excavation and Barge Spoil Disposal Have Developed Plant and Methods of Wide Utility

FOUNDATIONS not requiring the use of compressed air and designated, rather arbitrarily, as "open" constitute the larger number of all foundations. Even on Manhattan Island, New York City, where many of the world's most spectacular and difficult pneumatic caisson operations in building work have been carried out, this holds true. Except in those comparatively small areas made up of the lower end of the island and of narrow strips bordering the East and Hudson rivers, open foundations are usual. Their number too has increased with the unprecedented amount of building construction during the past few years. In addition, the constantly curtailed number of working days allowed for the final completion of buildings has made the foundation work the key operation.

These conditions have developed special methods and special equipment technique. Although practice is influenced by factors peculiar to New York, it is indicative of city building foundation contracting generally and parts of it may be applied in other cities where spoil

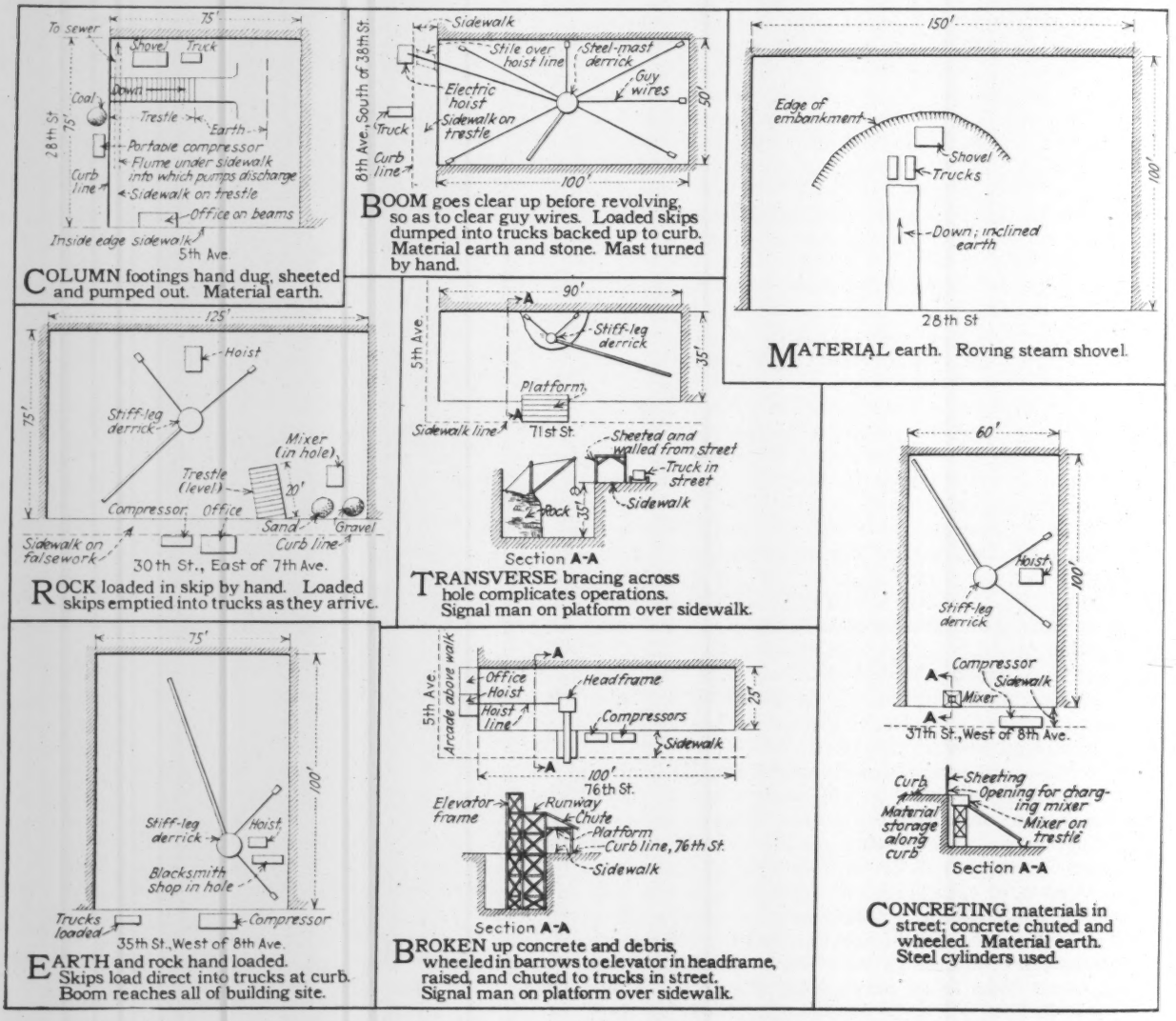


FIG. 1—TYPICAL FOUNDATION PLANT ARRANGEMENTS ON MANHATTAN ISLAND
Power shovels, derricks and combinations of the two are the basic equipment units.

disposal, underpinning, water handling, night work, and material storage are important items of foundation construction. In considering his collective task the New York foundation contractor finds that it is made up of approximately the following special tasks: Protection of the public; plant layout; site clearing and excavation procedure; water handling; underpinning; spoil disposal; and concreting. That will be the order of discussion here.

Safeguarding the Public—Fences around the building site have always been used, but it is becoming increasingly common to make these of tight boarding to shut off all view of the work from the street. The crowd which always collects wherever machinery is operating increases the injury hazard and the tight board fence discourages spectators. Watchmen are usually stationed at the entrances to the work and guards with red flags warn and stop traffic whenever any considerable blasting is done. Inclosed moving plant units, such as compressors, motors and engines are being used commonly. Obstruction of traffic, both pedestrian and vehicle, is prohibited by city ordinance, and plant layout and material storage are limited in a great measure by this prohibition. It requires too that interrupted travel ways be replaced with bridging and decking. Blasting is carefully regulated as to charges, use of mats, storage and handling of explosives, and time of firing. Large window glass is trussed and screens and shields are installed in necessary places.

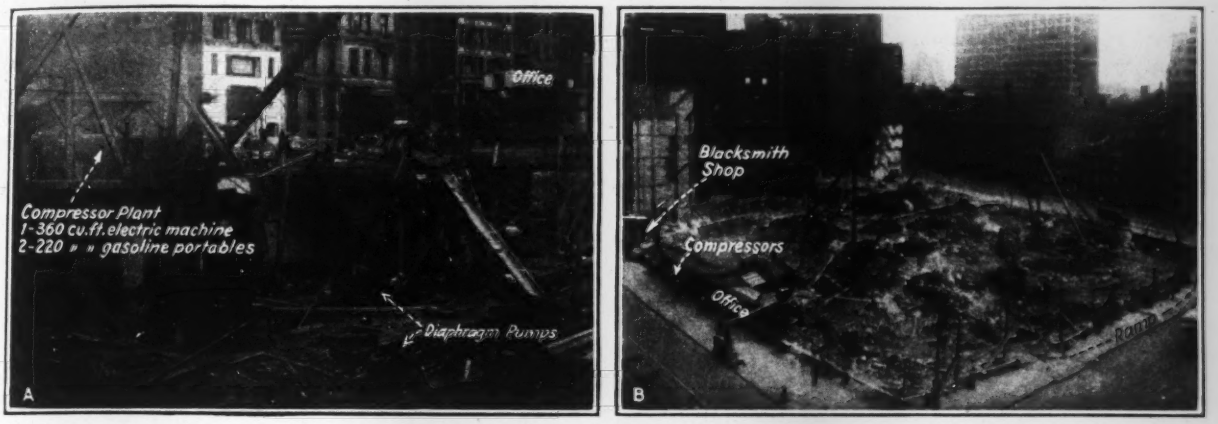


FIG. 2—TWO TYPES OF FOUNDATION PLANT

A—Units on trestles at street level; note office on trestle spanning sidewalk and diaphragm pumps on pier holes. B—Combination of derrick and power shovel units; derricks handle large stones and shovels the smaller ones; some of the débris from former building not yet removed from the site.

FIG. 3—DIGGING IN ON A NEW JOB

Foundation contractor's power shovels removing plaster and débris dumped into basement by building wrecker. Wrecking operations still going on at left side of picture.

Plant Layout—The sketches in Fig. 1 were obtained by making rough pencil drawings on actual jobs. Indeed, it is a rare contractor who makes a plant layout except mentally. The superintendent most often places his equipment to take care of conditions as he sees them, shifting it when necessary as he learns from actual operation where are the most economical locations for the units. Choice of equipment depends not alone on what is considered theoretically best for the job, but often is determined by what equipment the contractor owns that is not in use at the time the job is started.

Practically all plants are built around a power shovel, a derrick, or a combination of the two. The power shovel is the faster excavator, but it requires considerable yardage to be economical. One contractor places the required yardage at 1,000 cu.yd. for an average sized plot (50 x 100 ft.); another uses power shovels when 2,000 cu.yd. or more has to be moved. The maximum depth to which a shovel cuts on an earth job is about 15 ft. Going deeper than this requires sheeting and the resulting braces extending into the basement area do not permit shovel manipulation. In such cases derricks are substituted. These, in fact, become practically necessary for the pier-sinking operations. In rock excavation, where blasting is required derricks are usually used to place the mats. Power shovels can and in some cases do place these mats, but the procedure is slow and costly. On many rock jobs both a shovel and a derrick are used, the derrick handling the large stone with chains and the power shovel loading the smaller ones. The derricks are then also available for handling the blasting mats.

The width and location of the site also affect the choice of plant. As a general rule, power shovels cannot be used on interior lots less than 35 ft. wide. Corner lots even narrower than this permit power-shovel operations since the dipper can be raised above the curb level before swinging. Derricks, too, are practicable only for lots wider than approximately 35 ft., for the derrick sills are usually about 30 ft. long, to which must be added the radius of the swinging circle to get the minimum operating dimensions. On the narrow sites excavation is usually done by hand, loading into trucks that enter the basement on a ramp.

Since city ordinance allows only a 6-ft. encroachment on the street, most plant units are placed on trestles. Ordinarily the sidewalk must be kept open, but special permits are at times obtained to use the sidewalk space for material storage. On the trestles are placed derricks, truck-loading platforms, and concreting plant. Office buildings and tool houses are either on trestles spanning the sidewalk or else cantilevered over the excavation.

As noted, Fig. 1 shows a group of typical plant layouts. It will be seen that ramps are used with roving power shovels, those not having crawlers requiring corduroy roads on the basement floor. Derrick plants are of countless arrangements, but loading into trucks on trestle platforms at street level is common, when this type of plant is used.

Site Clearing and Excavation Procedure—Old buildings must first be torn down on practically every site. A wrecking company usually removes the old structure to curb level, leaving the walls and footings for the foundation contractor. Sometimes the wrecking company hauls all of the old material away, while on other jobs the plaster and loose debris are dumped into the old cellar. The latter method is coming into more general use and is probably more economical from the owner's point of view, since the wrecking company must handle the material in wheelbarrows, while the foundation contractor removes it with a power shovel. Occasionally walls and mass concrete footings, some nearly 10 ft. thick, must be blasted, but for the most part the power shovel demolishes them and loads the material directly into trucks.

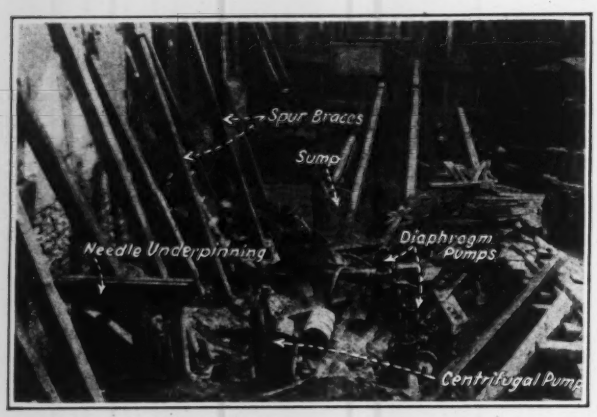


FIG. 4—WATER HANDLING BY DIAPHRAGM AND CENTRIFUGAL PUMP ARRANGEMENT
Diaphragms pump from pier holes into sump; the centrifugal pumps from sump to sewer and operates only as needed.

One factor that causes a variance in procedure on different jobs is the constantly changing geological formation and the varying depth at which solid rock is obtained. Core borings are usually given, extending into the rock approximately 5 ft. so that lump-sum bids can safely be made, except in certain very treacherous parts of the island. On the other hand taking jobs on the basis of wash borings has proved extremely costly to several contractors. An example is a job taken on the basis of wash borings and planned and contracted for on a total excavation of about 360 cu.yd. Before the job was completed the pier holes had yielded 1,200 cu.yd., the disposal of which entailed costly changes in the procedure. Ten wash borings had been taken, only one of which was substantiated. In each of the other nine cases a large boulder had evidently been struck and assumed to be solid rock.

This variable rock depth is at times so pronounced that different foundation methods must be used on the same job. On the site of a 44-story apartment hotel at 54th St. and 6th Ave., solid rock varied from 20 ft. below the curb at the front to 75 ft. below at the rear, representing a drop of 55 ft. in a 100-ft. lot. The front third of the lot was wholly excavated to solid rock, on the middle third rectangular piers were sunk and filled with concrete, while at the back steel cylinders were driven. In another case the rock varied from 20 to 60 ft. below the curb. On part of the site the earth was underlain by a stratum of disintegrated rock originally of a very hard character. Ten feet from this in one direction was found a stratum of mushy mica, while 10 ft. in another direction showed solid rock of a granite or trap variety.

On the Savoy-Plaza Hotel site, rock was found at from 50 to 75 ft. below the curb. Directly across the street north the contractor struck it 20 ft. below the curb. Incidentally, on the former job, described in *Engineering News-Record*, Sept. 23, 1926, p. 506, an underground stream was struck unexpectedly, which finally necessitated the use of air caissons even after the job had been started as open work. All these examples illustrate a condition peculiar to Manhattan Island that exerts an important influence on foundation sinking methods.

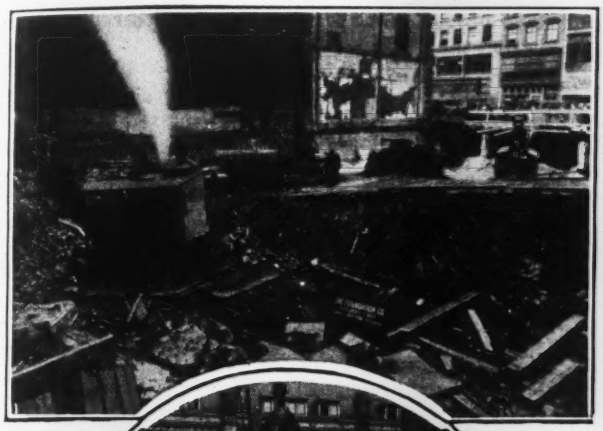
In quantity, solid rock excavation is small in comparison with earth and disintegrated stone. Most of it is required for boiler rooms placed below the general basement level and for the sub-basements often placed under the larger buildings. Methods used to excavate the rock and the looser materials vary to a certain extent, but since both occur on practically every job, many of the methods are adaptable to both classes of material.

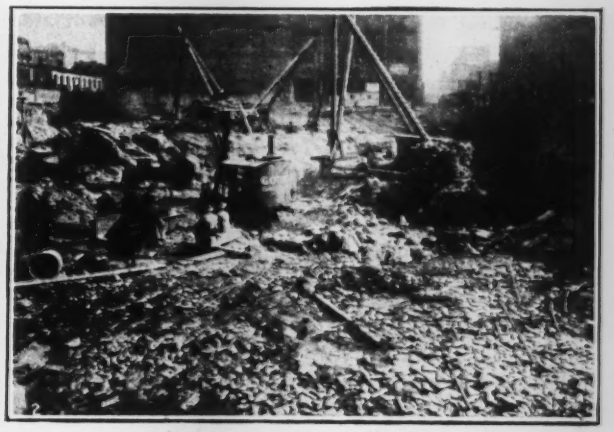
The two principal methods of excavation are built around the power shovel and the derrick. Power shovels ordinarily take the site down to a maximum of about 15 ft. below the curb, provided the area is large enough for the shovel to operate, as was pointed out in the section on plant layout. The shovel digs itself in, a ramp being left for a truck entrance and for removing the shovel. This preliminary ramp is a planked road laid on the incline by which the shovel entered the excavation. Beside this ramp is later erected a trestle ramp permitting the preliminary ramp to be removed by the shovel. This is the usual method. Another plan is to back the shovel up the ramp, removing the excavation by hand into skips and handling to trucks by the shovel boom. Practice indicates that a ramp of about 1 on 4½ is the maximum that should be used for economical truck operation.

The use of a derrick requires a somewhat different procedure. Trucks do not come into the hole but are loaded either at the curb or on trestles at the street level. Small stones are loaded by hand into skips and transferred to the trucks by the derricks, while the derrick drop lines hoist the large stones one at a time. The derricks are placed as near the edge of the lot as possible so as to cover the maximum area from the first set-up. There are always two set-ups, the second being necessary to remove the excavation where the first der-

rick originally stood. From the first set-up all the area possible is excavated to basement grade, so that pier sinking operations can proceed immediately, and concurrently with the remainder of the excavation to basement level. Ordinarily one derrick can handle a plot solid rock. Wooden sheeting is ordinarily used, although steel sheetpiling is sometimes driven. Derricks are necessary for pier excavation. Small buckets, about 3 ft. high and 2 ft. in diameter, are loaded by hand in the bottom of the pier holes and removed by the der-

Fig. 5—Sinking Open Foundations on Manhattan Island





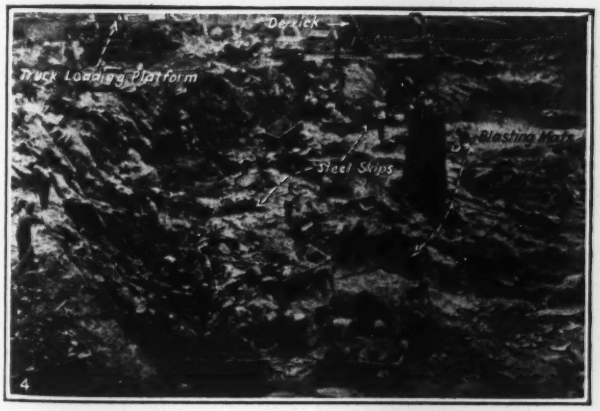
1—TRUCKS LOADING STEAM SHOVEL IN HOLE
A trestle ramp was later built so that the earth and stone under the ramp shown could be removed. Fig. 10 shows same site during concreting work.

2—ROCK EXCAVATION FOR NEW MADISON SQUARE GARDEN
Both derricks and steam shovels used to remove 50,000 cu.yd. of solid rock on this site.

3—NECESSARY EQUIPMENT OFTEN CONGESTS THE SITE
On this job trucks were loaded at the street curb by the derrick.

4—ROCK EXCAVATION FOR BOILER ROOM 37 FT. BELOW CURB
Note blasting mats being placed by derrick.

5—STEEL CYLINDER FOUNDATION JOB
Pile hammers used both in leads and on end of derrick drop lines to drive steel cylinders.



50 x 100 ft. In changing set-ups two alternatives are available. The first derrick may be torn down and re-erected on the basement floor, or an extra derrick may be first erected on the basement floor and used to remove the first derrick. The latter method is believed by several contractors to be quicker and cheaper.

The procedure so far described takes the excavation only to basement floor level. Below this the various piers for the building columns are sunk by hand to rock. The sheeting is ordinarily placed vertically. However, on deep piers vertical sheeting tends to drive out of line, and some jobs require horizontal breast boards.

Piers are usually small so that not much material has to be removed, although the varying depth of rock, previously referred to, makes some of them quite deep and yields a substantial quantity of spoil. This is not serious provided the contractor knows from core borings just where to expect the rock. The case

cited previously, where 1,200 yd. of excavation was necessary on a job bid in as 360 yd., is a case in point. On this job the contractor's original plan of procedure was interesting. He calculated that the excavation from the piers (based on wash boring indications) would about cover the foundation site to a depth of approximately 4 ft. Accordingly, he excavated the entire foundation area to 4 ft. below the cellar floor, contemplating dumping the spoil from the piers directly outside of the holes, and thus filling up the area to the required level. Most of the borings were actually about 10 ft. short of the actual rock location, and in some cases a 30-ft. difference was found. Thus, the excavated earth soon piled high around every pier hole and a costly operation was necessary to remove it, since the contractor had no derrick on the job. The material was moved to the bottom of a ramp by wheelbarrows and loaded into trucks by hand.

Another method used on many open jobs in sinking from the basement level to solid rock is to drive steel cylinders, blowing them out with compressed air and immediately filling them with concrete. These cylinders are usually put down in clusters, over which a concrete cap is placed to carry the building column base. The cylinders have been driven to depths of about 100 ft., pipe in 20-ft. lengths being used coupled together by cast-steel internal sleeve couplings. The cylinders range in diameter from 10 to 16 in. outside. One advantage claimed for this method is that since disintegration of Manhattan schist is extremely fast, the immediate pouring of the concrete in the cylinders prevents the disintegration from taking place.

Two types of plants are used to install steel cylinder foundations, one a derrick, the other a pile hammer in leads. Probably 70 per cent of the cylinders are driven by hammers hung from derrick boom drop lines. Leads are economical where seven or eight cylinders occur in a cluster, but it is extremely costly when the lead structure, consisting of the hammer leads, hoisting engine and boiler must be frequently moved. One derrick can handle a site 60 x 100 ft. while a 100 x 100-ft. plot would probably require two derricks. Besides the derricks or leads, this type of job requires a compressor and air receiver.

Water Handling—Water is present on most of the jobs, but in the area of the island being considered the pressure is seldom so great as to render pumping inadequate. Diaphragm pumps, either gasoline-engine or electric-motor driven, are most often used, pumping continuously. On some jobs by pumping several adjacent holes the water level can be lowered sufficiently for a large part of the work to be done without hindrance.

One contractor has had several jobs where the geological formations occurred in such arrangement that by sinking a pier on each corner and pumping them continuously, the remainder of the site was kept practically dry. Disposal of the water is usually not a problem, since sewers are nearly always accessible. In some cases, the water has to be flumed around the site and in others the discharge hose from the pump is long enough to reach an outlet. Another contractor uses a very effective combination of diaphragm and centrifugal pumping units, when the sewer is at some distance from the site and considerable pressure is necessary to lift the water to the discharge outlet. A sump about 10 x 10 x 10 ft. is sunk below the basement floor level. Six or seven diaphragm pumps are placed on the pier holes, pumping continuously into this sump. Whenever the sump becomes full, a 3-in. centrifugal connected to it and discharging into the sewer through a wooden trough is started. An important detail on this particular job is that the outlet in the trough to the sewer is about 2 in. above the bottom. Thus a settling basin is provided in the trough and much sediment is kept from the sewer.

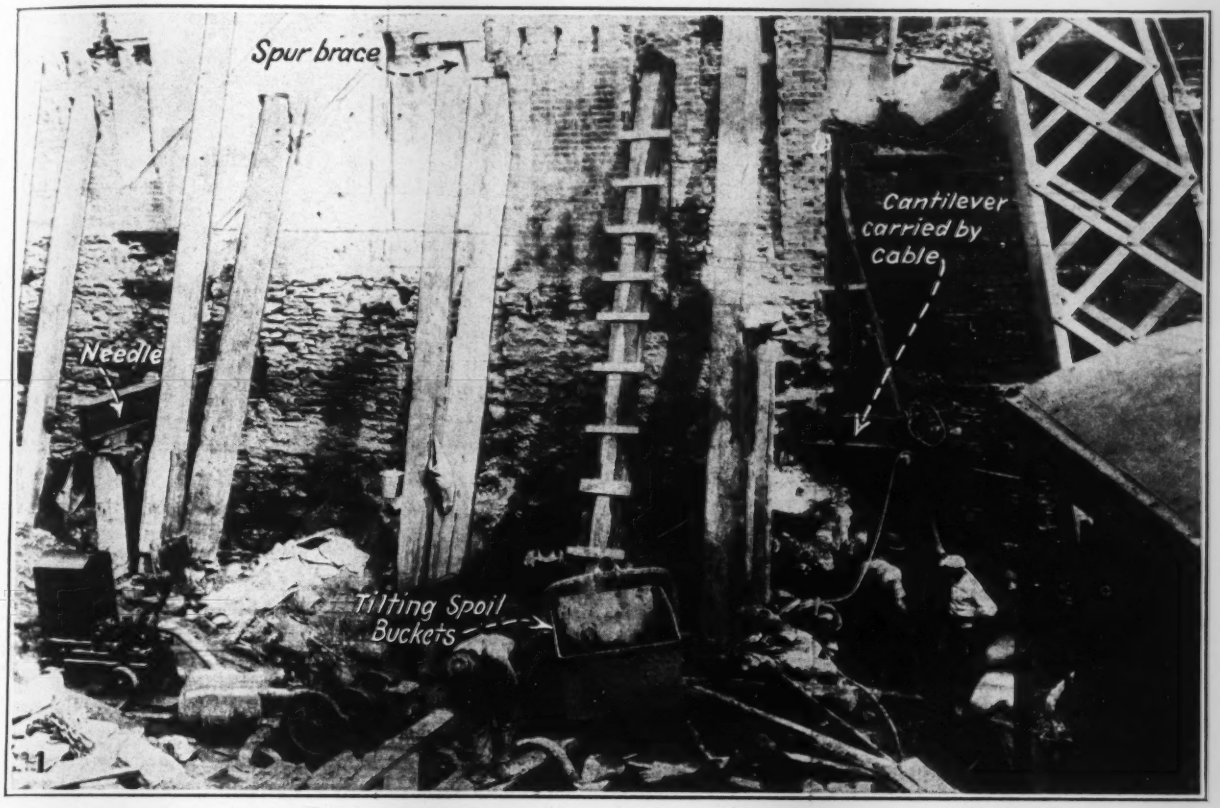
Underpinning—When the foundation site is flanked by old structures, the new foundation is usually below the old wall footings. This necessitates underpinning the old wall and often results in one of the most important and difficult operations of the entire foundation task. Fig. 6 gives some idea of the methods used. The underpinning operation consists essentially in building up a concrete wall from solid rock to the bottom of the old building wall, putting flagstones directly under the building, and using iron wedges and grout to reach a final bearing. A slight variation and one not requiring flag stones is to place a short lip on the concreting form, enabling the concrete to be poured up very close to the bottom of the building wall, after which a dry mix and iron wedges are forced in. These methods are rather generally used, the main variance in the underpinning work arising in the manner of supporting the old walls while the underpinning is being done.

A method used quite extensively by one large contractor is to leave piers of earth to support the old wall, excavating alternate pits to bedrock. In these pits piers are concreted up to the old wall and wedged up to take the load. The earth piers are then excavated and the underpinning wall made continuous. No special supports are used for the old walls with this plan. With other methods inclined braces are used bearing against the old walls some 20 to 40 ft. above the basement floor. These are known as pushers and as spur braces. As generally understood, the pushers are not intended to carry the wall, being merely designed as supports to steady it from jar. The spur braces, however, are intended to carry that part of the wall above their tops. The wall below the top of the spur braces is commonly carried in one of two ways. A cable may be placed over the top of the spur brace, supporting the outer end of a cantilevered I-beam inserted in the wall. The second alternative is to support this I-beam by a post resting on the basement floor rather than by the cable sling. The load is taken by means of a screw jack placed under the end of the beam, the post, in fact, being merely a safety precaution in case the jack slips. The latter type of support is known as a needle beam. When using a method requiring spur braces and needle beams, the entire earth support is not removed at once, but a berm about 5 ft. on top and 8 ft. on bottom that has been left alongside of the building, by the power shovel or derrick excavating the basement, is taken out about 5 ft. at a time as the underpinning is brought up to the bottom of the old wall.

Disposal of Excavated Material

The problem of spoil disposal on Manhattan Island is made more difficult by the waterways surrounding it. The Hudson on the west is unbridged while the East River bridges leading to Long Island are carrying the ultimate in traffic load practically all of the time. Fill-

Fig. 6—Underpinning Building Walls Adjacent to Foundation Site—Manhattan Island



1—THREE TYPES OF WALL SUPPORTS
(a)—Spur braces supporting upper part of wall; (b)—needle beam supporting wall below spur brace and aiding the latter in supporting the upper part of the wall; (c)—cantilever beam carried by steel cable supporting wall below spur brace.

2—UNDERPINNING WITHOUT ARTIFICIAL SUPPORT
Alternate piers of earth are left in until concrete is poured up to the walls; following this, earth is removed and concrete underpinning wall made continuous. Braces or pushers do not support the wall, but merely steady it.

3—SPECIAL BRACING TO SUPPORT MASONRY WALL

FIG. 7—TYPICAL NIGHT VIEW OF FOUNDATION OPERATIONS, MANHATTAN ISLAND

ing requirements and building stone operations on Long Island could easily take care of all of the spoil but on account of the traffic congestion much of it finds its way to the piers where barges carry it to sea or to filling operations along the New Jersey coast. The excavated material from the new subway is being used to extend Riverside Park along the Hudson River but this is a special case and does not help building excavators.

The organization that has been set up to take care of spoil disposal consists of a countless number of haulage companies and several large companies operating barges and tug boats. Most of the trucks are owned by individuals, very few concerns having more than five machines. However, larger hauling companies rent the individually owned trucks and thus can operate in the aggregate a considerable fleet under their own name. One recognized advantage of individual ownership of the truck is that since haulage is done on a load basis the owner will try to make as many loads as possible per day, while the employee of a trucking company has no such interest.

Exact figures are not available as to the total amount of excavated material that is disposed of. One contractor estimated that 10,000 cu.yd. a day was a year round average for material from foundation work that left Manhattan Island. This, of course, included both truck and barge haulage. On the other hand, one barge firm estimated that it alone took 5,000 cu.yd. a day to sea. Since there are two barge companies larger than this one, it seems probable that the estimate of 10,000 cu.yd. a day leaving the island is somewhat low.

All material that is towed to sea is under the direction of the Supervisor of New York Harbor who is a representative of the War Department. There is available in his office a record of the total amount of material passing from the harbor but the figures also include garbage and refuse. However, the material going to filling operations along the Jersey coast aggregated 10,000,000 cu.yd. for the fiscal year ending June 30, 1925. For the month of June, 1926, 292,629 cu.yd. were towed to the same place. This is an average of nearly 10,000 cu.yd. a day which added to the amount dumped at sea and the

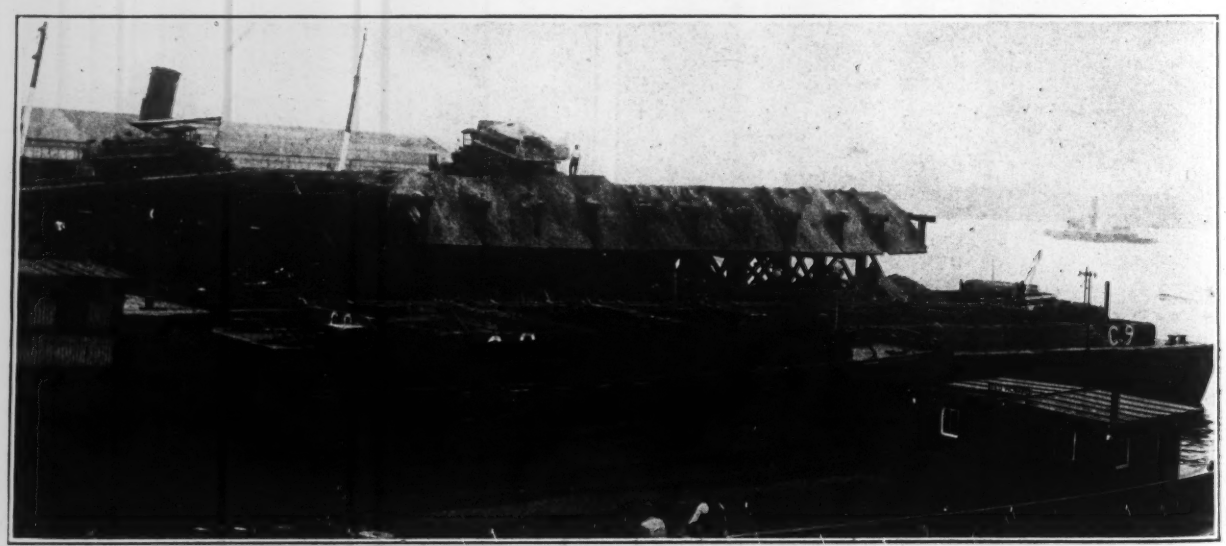


FIG. 8—DUMPING BOARD FOR BARGE LOADING
Earth hauled to sea and dumped. Rock loaded at other piers by derricks, and disposed of as fill along Jersey coast.

amount placed in fill on Long Island, brings the average daily total of foundation material leaving Manhattan Island to over 15,000 cu.yd., probably near 20,000 cu.yd. It is estimated that about 30 per cent of the total goes to Long Island.

There are four main companies operating dirt and rock dumping boards on Manhattan. The map, Fig. 10, indicates the location of the piers upon which dumping boards have been constructed and also shows the company operating each one. These companies rent the piers. Fig. 8 shows a typical dumping board used on one of the Hudson River piers. Trucks reach the upper platform by a ramp and dump by gravity into the barges alongside the pier. The platforms are usually cantilevered out over the scows so that the trucks discharge directly into them. Two types of barges are used, a bottom-dump and a deck design. The bottom-dump barges are the more numerous. The capacities of each type range from 500 to 1,000 cu.yd. each. As the barges are loaded they are towed to sea by tug boats each of which handles two or three barges. Rules require that the dumping shall be at least 4 miles out through the Narrows and the lower bay to 4 miles east southeast of the Scotland Lightship in 17 fathoms of water. The round trip to this point and return is made in about 13 hours.

In some cases bulkhead dumping into the barges is used. This usually requires that the trucks empty the material in the street from which it is rehandled by a derrick and clamshell bucket to the barges below. This is both slow and costly especially since city statutes require that all the material must be cleaned up from the streets by night. Rock cannot be disposed of over the earth dumping boards since large stones have been known to sink the barges. Rock barges can be loaded at practically any pier that has a derrick available; when a large rock job is undertaken the haulage contractor often rents what piers he needs and fits them up especially for rock handling.

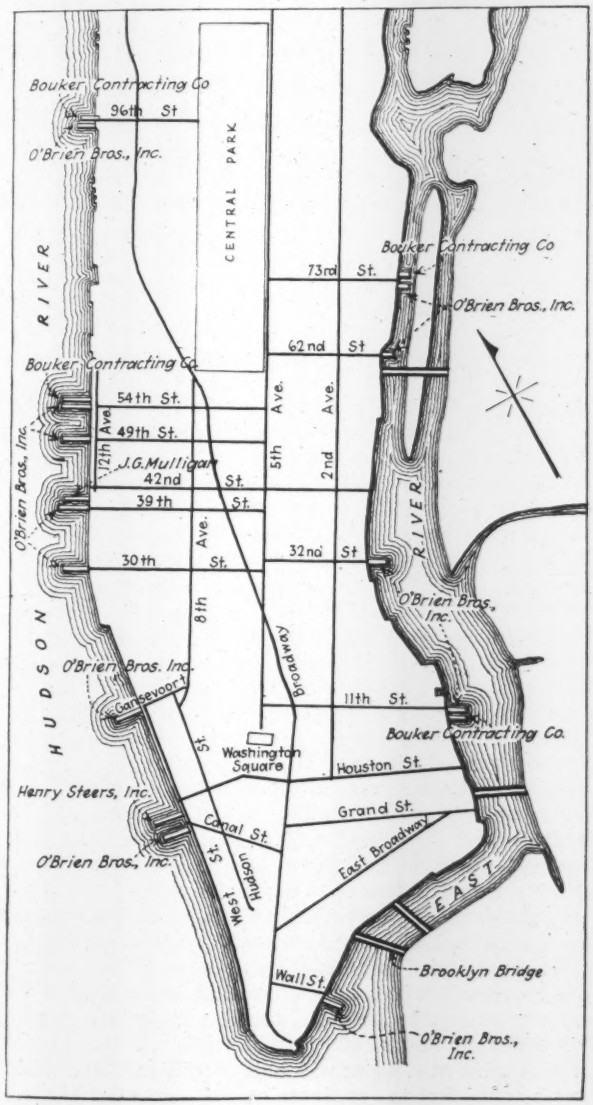


FIG. 9—LOCATION OF EARTH DUMPING BOARD PIERS AROUND MANHATTAN ISLAND

FIG. 10—CONCRETE PLANT FOR FOUNDATION PIERS

Note diaphragm pumps each handling about two holes; also office cantilevered over excavation; both sidewalks are shored.

The large firms, of course, try to sell all the material that they can for fill. The development at Port Newark is now requiring a large part of the rock. At different times Staten Island has been a dumping point as has also the Western Electric plant at Kearny, N. J. There is no special co-operation between or co-ordination of trucking operations and barge movements. Trucking companies haul the excavated material to the most accessible pier paying 60 to 70c. a yard to have it hauled to sea. Except in the case of one barge company there is no contract between the barge and trucking companies, each truck-load being sold separately. The barge company that operates on a contract basis dumps only for fill and all contracts for fill work taken are usually large.

Acknowledgments—Special thanks are due the following contractors for the majority of the illustrations appearing with this article and for the information upon which it is based: Foundation Co.; Godwin Construction Co.; Marcus Contracting Co.; and Spencer, White & Prentis. Information on the spoil disposal methods was supplied by Moran Towing and Transportation Co.; O'Brien Bros., Inc.; Bouker Contracting Co., Henry Steers, Inc., and by Capt. K. M. Bennett, U. S. Navy, Supervisor of New York Harbor.

The Civil Engineer in Industry

—AN EDITORIAL SURVEY—

III. Industrial Staff Engineers and Constructors

The Third of Four Articles Reporting the Results of a Study Into a Little Appreciated Field of Civil Engineering

IN THE study of engineering work in industrial plants, the results of which are partially set forth herein, it is evident that among large industries, particularly those involving so-called secret manufacturing processes, there is a growing tendency toward the building up of technical staffs to take care of all civil engineering and construction work necessary for the industry's reconstruction work and physical expansion. In fact, some of the industries which *Engineering News-Record* has surveyed have construction organizations doing an annual business which in dollars and cents would rate high with some of the large general contracting organizations. In order fully to set forth the manner in which such forces are organized, the work they do administered, and the degree to which they go in doing their own work, explanations will be made as to how the Du Pont Engineering Co., Eastman Kodak Co. and Great Atlantic & Pacific Co. operate.

There are several well defined reasons accounting for this tendency. In the first place, a manufacturing plant which is a large purchaser of construction materials and equipment can take advantage of cash discounts by handling the purchases through the purchasing agent of the industry itself. Few contractors can take advantage of all cash discounts. The industry's saving represents around 10 per cent on the price of construction materials. As the price of materials is approximately a third of the total cost of the completed structure, this is no mean item. What the saving is can best be appreciated when it is known that many of these large industries do from $5,000,000 to $10,000,000 worth of construction work yearly.

In the second place, industrial plants with a wide variety of manufacturing processes must have varied types of construction. The men best suited to design and superintend construction of such plants, those who have used the system believe, are men acquainted with the type of machinery to be installed. If, on the other hand, the kind of manufacturing demands a single type of building which can be so standardized that new construction is largely multiple-unit work, greater expedition in both design and construction is possible. Also, greater facility and therefore less expense come by repetitive building.

There also is found in several large industries a disposition to keep all of the company information within the official family. In other words, some manufacturers believe that construction and design are so a part of manufacturing that if processes are secret and profits depend upon their retention, the details of building cannot well be considered public property.

Before proceeding with the discussion of the Du Pont organization, the way one large manufacturing establishment, with branches all over the country, operates will first be explained. This manufacturer, for personal reasons, wishes its identity to remain concealed.

Considerations of economy in design and construction were principally behind the establishment in this large industry of an engineering department prepared to carry through the details of design and construction of whatever renovation, extension, or new construction which this commercial organization finds advantageous to make or construct. In the engineering department, which numbers around 50 men, all of the engineering and construction work having to do with some 65 plants scattered throughout this country and Canada is handled. The engineering department carries the work up to the point of actual installation of machinery.

Standardized on Types—During the past few years this manufacturer has standardized on reinforced-concrete factories and warehouses of five or six stories. In new layouts, where unlimited ground is available, a standard design is followed, the size of the complete plant depending on the desired number of production units. In those cases wherein extensions are made to existing factories, harmonizing the available space, the actual physical extensions and manufacturing needs and units, is necessary. In such instances, unusual building designs may be resorted to.

It appears, therefore, that the chief consideration of the engineering department of this concern is building standard factories, and it does it with an organization headed by a man of long experience in civil engineering work. The construction superintendents have been recruited from construction companies of wide experience. The assistant chief engineer, who perhaps is closest to both design and construction, has had extensive experience with contracting companies.

The construction work which the company does is divided about half and half between contract and force-account work. The usual procedure is to ask for bids upon all new projects. The engineering department also makes its estimate and if the bid appears much higher than that for which it is believed the work can be done privately, bids are rejected and the engineering department supervises the construction. The keeping of accurate cost data, the analysis of construction details under repeated observations, the acquisition of a quick facility that comes only after repetitive building of like units under varying conditions and climates, and the reduction of design and construction details to standard methods have all had their part in the ability of the engineering department to underbid contractors. Then, of course, there also enters the ability of the company to buy its materials for spot cash.

Processes of Work Standardized—As an indication of the manner in which the engineering department is able to shave construction costs, there is the case of a plant constructed during 1925 in the Mid-West. On this job, which amounted to nearly half a million dollars, bids were called, but the engineering department, after close figuring of details and minute examination of the local materials market, decided it could do the job for less

than the lowest price bid. Setting aside a construction fund equal to the estimate, and creating a 10 per cent contingency fund, the job was begun. When it was finished in record time, it was found that not only had the building been erected at a cost slightly below the estimate, but not a cent of the 10 per cent contingency fund had been spent.

It is rather difficult to outline the engineering work which this manufacturer is doing without explaining what the activities of its assistant chief engineer have been. Before leaving the construction company which he formerly served he had made rather an intimate study of the unit cost of concrete construction. In his present work these investigations have been amplified and he is now compiling standards for distribution among his construction superintendents. The standards cover every detail of the design and construction of the type of building in which the company specializes.

This book of standards includes such general headings as General, Architectural, Estimating, Construction, Structural, Design, Electrical, Heating, Machinery, Specifications, and Ventilation. Under the chapter headed "General" are such data as mathematical tables used in either design or estimating computations, sizes of drawings, titles for drawings, etc. Under the chapter headed "Estimating" are found the analyses of unit costs. Not all of these unit costs are as yet available, but all the data are being compiled as the jobs are finished and arranged under their proper units in order ultimately to estimate the cost of construction of any plant within the smallest possible per cent of variation, no matter what the climatic or geographical conditions are nor how near or how far the plant is from sources of materials and labor. The chapter of the book on Construction includes the methods used by the engineering department in soil tests, foundation borings, formwork erection, shoring and underpinning, and the construction and use of tools.

When this book of standards is completed a construction superintendent should be able to complete the job within the lowest possible estimate, for he will have at hand all of the experience gained in construction by other men on previous plants. There will not be a detail with which his work is concerned for which he will have to seek data outside of his own book of standards.

Materials and Equipment Purchases—Even though new plants or extensions are let to contract, the company reserves the right to purchase the principal building materials in the open market and to furnish them to the contractor. This is particularly true of cement. The company is such a large purchaser of window sash that this item also is furnished, its installation being usually a subcontract in case the whole job is let to a general contractor. As an indication of the extent of building material and installation purchases which the company makes, a fair assumption can be made at somewhere between 30 and 35 per cent of its $3,000,000 to $4,000,000 building program per year spent on these items. This includes not only steel, concrete, gravel, crushed rock, cement and the other building materials, but window sash, electrical supplies, heating units, ventilation systems, and plumbing supplies. Machinery for actual manufacturing processes is, of course, an additional cost.

The engineering department keeps about three construction superintendents usually in the field. A new plant costing under $1,000,000 has just been completed in the Middle West and another is contemplated to cost $1,000,000 on the West Coast. When the company itself actually does construction work, it usually ships heavy equipment from one job to another. For instance, towers for concrete chuting, mixing plants, hoist derricks, and such heavy equipment are shipped from one job to the next. Also, small tools, which are easily packed and upon which the transportation costs will not be so great as to make it inadvisable to ship, are sent on to the next succeeding job. As a means of checking up on the progress of work under way, the construction superintendent makes a daily report to the chief engineer.

Du Pont's Organization

The engineering department of the E. I. du Pont de Nemours & Co., of Wilmington, Del., is so organized that an explanation of its ramifications will be of value. In the first place, all of the design and construction work undertaken by the Du Pont company or any of its subsidiaries is done by the engineering department. If the work concerns the parent company or one of its subsidiaries, the engineering department is known as such. However, if the directors of those industries in which du Pont is interested but does not hold a major amount of stock agree to engage the engineering department of the du Pont people to do the construction work, the engineering department operates as the du Pont Engineering Co. In the latter case, the engineering department takes the job as a contract without profit.

Division in Engineering Supervision—Broadly, the engineering department, which is presided over by a chief engineer, is divided into the mechanical-experimental, operative engineering, design division, and construction division. The mechanical-experimental division is composed of a few men who may be called upon by any branch of the manufacturing company or subsidiary companies for expert technical information. This division is practically a pure science organization and might well be termed a department composed of dreamers. Operative engineering is concerned primarily with the efficient and economical operation of over 50 plants. Special studies are made on belting, power consumption, and such other things as fuel oil vs. coal and the adaptation of particular motors to specific work. The design division contains architects, engineers and planners. It is to this division that a work order which may emanate from any one of the four manufacturing departments goes first. Preliminary drawings are then made and submitted to the construction division for cost data. All this material is then submitted to the board of directors. If authorization for the building is given, the work order is resubmitted to the design division and details which the construction division can follow are drawn up. When fully designed, the work is turned over to the construction division to build. The construction division is really a contracting organization working without profit.

The du Pont Co. designs and builds its own plants and subsidiaries because men in their own organization know best the structural needs for specific manufacturing processes. The activities of the du Pont interests are so widespread that it is thought best to keep within the organization a staff of experts for deciding every conceivable issue concerned with investigation, design, construction, and operation.

To give an idea of the broad field which the du Pont interests cover, its engineering department is almost constantly concerned with either reconstruction or new erection problems for such industries as explosives, paints and heavy chemicals, Duco, Fabrikoid, Pyralin articles, dyes, photographic films, artificial silks, alcohol and ammonia. These are but a few and even some of them have many subdivisions. Before any plant is brought to the construction stage, considerable investigative work is necessary. Investigation of plant sites, incidentally, is in the hands of a civil engineer. Where a large plant is to be constructed, consideration must be taken not only of availability of construction materials to the site, accessibility, ease of construction, etc., but innumerable manufacturing needs. Proximity of fuel and labor supplies and cheap water power and also, particularly for the manufacture of Rayon, clear, soft water will outweigh construction considerations. This investigating engineer often will spend from six months to a year in weighing all of the available sites before that one is selected which will give the best average for all issues involved.

Annual Business Large — Just what the annual amount of business which the du Pont Engineering Co. does is difficult to say. This one figure can, however, be given. During 1925 for materials and labor alone it spent approximately $16,000,000. Not all of the projects are large. Some may require but a handful of men and a few weeks, while on a job such as the Rayon plant constructed near Buffalo last year approximately 2 000 men were employed. However, large or small, each one of the several hundred live projects which the engineering department considers yearly is given expert engineering advice from every possible point of view.

Rather an interesting detail in the organization of the design division is the employment of a series of project engineers. These project engineers are chosen so that each plant, no matter what it is designed to manufacture, is given expert attention in the design stage. Thus, if a dye plant is projected, one of these project engineers (in this instance a chemical engineer) is consulted first. When that project engineer has indicated the exigencies of the manufacturing process, the practical design is made and the procedure towards construction and operation follows as explained above.

Aside from the actual design and construction of the various plants for the du Pont people and subsidiaries, the engineering department engages in a number of less technical activities. It has a certain connection with the actual manufacturing, because among its principal non-technical responsibilities are increase in production, power and fuel problems, mechanical problems of operation, ventilation and air conditioning, fire protection, treatment of wastes and byproducts including waste heat, handling and routing of materials, water supply and purification, reports and appraisals, and numerous small problems connected with village administration, for the creation of manufacturing villages in practically unpopulated areas is often necessary. It also assists the real estate agent for the company in the appraisal of plant values.

Eastman Kodak Co.

Manufacturing processes have imposed upon the engineering department of the Eastman Kodak Co. at its Kodak Park (Rochester, N. Y.) plant some very interesting and unusual problems. Though a number of considerations are involved, it is probable that two of the most compelling reasons why this plant has done its own engineering and construction work exclusively are the secrecy of manufacturing processes and wide variety of incidental manufacturing, and economy and facility in construction.

Some idea of the extent of Kodak Park and its ramifications may be gathered from the fact that the output in motion picture film alone has exceeded 75,000,000 ft. per month. Into the manufacture of this film (photographic film, papers, dry plates, chemicals and developers are the principal output of the Kodak Park works) goes nearly 5,000,000 lb. of cotton per year and into the sensitizing of various products over 3 tons of pure silver bullion every week. This is one-eleventh of all the silver mined in the United States. Thousands of tons of acids required for nitrating this cotton and silver are manufactured at the park. Kodak Park is the largest of the four Rochester plants and consists of about 230 acres, steel and concrete buildings having a floor area of 88 acres. Buildings under construction will add several more acres of floor space.

Organization of Engineering Work — Broadly, the engineering department of the Kodak Park works includes all civil, mechanical and electrical work, together with automatic machinery supervision. Under the superintendent of this engineering department, there is handled an extraordinarily wide range of general and special engineering problems. The principal subdivisions of the engineering department are presided over by a construction engineer, electrical engineer, civil engineer, power engineer, automatic machinery engineer, and a division comprising the master mechanic and his staff and that of the mechanical engineer. All of the construction work is dirctly handled by the construction engineer and his organization is a separate entity. Practically, he is president of a large contracting organization which has charge of all building in the park and which runs a labor pay roll alone of approximately a half million dollars yearly. This construction organization buys all its own equipment, but construction materials, particularly cement and steel, are furnished by the Kodak company. In other words, here again the parent organization, because of its tremendous buying power, is able to take care of any purchases for spot cash, thereby saving considerable on the discounts.

The civil engineer is responsible for the design of buildings which the construction engineer erects. Officials of the company feel that it is distinctly advantageous to have men continuously employed who can do everything in connection with engineering or construction work. This is a great deal more understandable when one visits the plant of the Kodak Park works than other establishments where the same condition prevails.

The all important problem in the manufacture of film or other sensitized material is drying. Also, in dealing with sensitized paper the work is dark-room work. These two manufacturing considerations have had a decided effect on the type of structure erected. The buildings are long, low buildings, often with blank walls and floors and side walls must be acid-resisting and waterproof. There is no uniformity of column spacing from building to building, nor is there much uniformity in other structural details. This makes every building erected practically a new problem wherein the machinery to be housed is the principal consideration. The

buildings now contained in the Kodak Park works are of various exterior finishes and various structural elements, though latterly there has been more reinforced-concrete building work done than any other type.

Engineering Affected by Manufacturing Uses—Outside of the general building construction work, the manufacturing processes imposed numerous special engineering problems. For instance, as moisture or variations of temperature would be fatal to uniform film quality, the great rooms in which film is sensitized and handled are kept at uniform temperature and humidity by a constant supply of conditioned air. Refrigeration for this purpose is maintained by five ammonia compression machines of 2,400 tons capacity, which are supplemented by five compound compression machines of 3,000 tons capacity—a total capacity equal to the melting of approximately 5,400 tons of ice every 24 hr., or a quantity sufficient for a city of some 200,000 people. As this conditioned air must be distributed to all parts of the plant, overhead pipe-line construction imposes a considerable problem.

Steam is supplied from two power houses, one in which 20 boilers are installed, developing 12,000 hp., and a second in which four boilers develop 4,000 hp. The power houses are separated by a distance of about a mile and high pressure steam is transmitted this distance through a specially designed 12-in. all-welded pipe line.

Private Water Supply—Kodak Park has an inexhaustible private water-supply system connected directly with Lake Ontario 6 miles away. This supply is solely for manufacturing uses, the potable water being taken from the city mains. A pumping station on the lake shore with a capacity of 16,000,000 gal. pumps the water through a 24-in. main to a 5,000,000-gal reservoir in the park. The pumping station there, with a capacity of 15,000,000 gal., maintains a pressure of approximately 100 lb. in the 100 odd hydrants and 8 miles of 6, 8, 10, 12 and 16-in. mains that gridiron the park. As water for manufacturing uses must be absolutely free from impurities, a large filtration plant is maintained at the lake shore pumping station. The plant is a rapid sand type with eight units in normal operation, though designed for twelve. As water for manufacturing purposes must be of a constant hardness and free from suspended matter, the intake was set 8,000 ft. into Lake Ontario. That part of the pipe line which is in the lake is lock bar pipe of 42-in. diameter.

Though as previously stated the potable water is taken from the city mains, the State Board of Health has been making a series of bacterial analyses of the water used for manufacturing to discover its potability. Extraordinary precautions are taken to avoid cross-connections between the two supplies, though there apparently is little present danger of typhoid, double check valves being installed when necessary.

An interesting engineering detail in connection with the harmonizing of the various manufacturing units is found in a building completed during 1925. A 5,000,000-gal. storage reservoir was constructed. This reservoir had to be covered, so to economize on space a two-story building for storage of film was built over the reservoir and the first-floor slab serves as the reservoir cover.

Labor Task and Bonus System — The construction division of the Eastman Kodak Co. has gone far in what it believes to be the best system in the efficient and economical handling of construction labor. Practically all work outside of common labor is performed on the task and bonus basis. The construction department in cooperation with the industrial research division of the company has established a task as a measure for practically all of the principal construction operations. If a workman surpasses this task, he is eligible to receive a bonus. It is rather difficult in a number of instances to establish a task which is perhaps fair to both employer and employee, but by and large, the system, officials of the company feel, has been of tremendous benefit in keeping the construction organization together, satisfied and continuously employed.

There is no hard and fast regulation which fits a workman in a particular craft. If for instance a bricklayer thinks he would make a better form setter, he is given the opportunity of trying. If after a reasonable length of time he shows greater adaptability to the new work and is able to meet or surpass the task set for the particular work he is doing he is allowed to change. The Eastman people believe that this flexibility in construction labor is a decided asset.

Great Atlantic & Pacific Tea Co.

In the foregoing three instances, design and construction have been largely supervised by engineers and construction men actually employed by the respective industries. There are variations to this condition. For instance, a number of industrial establishments will maintain engineering forces to design but not construct and vice versa. Of the former class is the engineering department of the Great Atlantic & Pacific Tea Co., whose executive offices are in Jersey City, N. J., and whose retail stores are to be found in every part of the country.

For executive purposes, the Great Atlantic & Pacific Tea Co. is divided into six units, each one being in charge of a director of operations. The engineering department serves each one of these directors where problems concerned with actual physical property arise. There are only 8 or 10 men in the engineering department, but the small staff is explainable largely by the fact that building is standardized and all work is let to contract.

Designs, but Does Not Build—The reason why the company does not undertake to build its own factory and warehouse space is twofold: In the first place, most of its warehouse space is occupied on short-term leases. Then, too, a tradition has arisen in the engineering department that greater ultimate economy lies in letting all building operations to contract. It is believed that what cost might be saved by the company doing its own building will be more than offset by the necessity for keeping on hand a large stock of construction equipment and shipping it from one job to another.

Inasmuch as from 2,500 to 3,000 new retail stores are opened yearly, extensions in warehouse and factory space and entirely new warehouses and factories must be provided in large number. The building of this latter class probably runs close to $2,000,000 a year with two-thirds of that amount in addition representing manufacturing machinery. When a new warehouse is contemplated, the Great Atlantic & Pacific Tea Co. presents its banker with plans and specifications. From then on, what method of building is followed is left more or less to the banker. If he, when presented with precise information as to how the factory is to be constructed,

wishes to let the contract without engagement of further architectural or engineering service, the tea company will furnish all details and working drawings for the contractor.

However, the banker who may think that in such procedure there is some possibility of a poor construction job frequently engages his own architectural and engineering service, though the design must be that provided by the engineering department of the tea company. At the present time the tea company has had such extensive construction dealings with outside financing that bankers have become pretty well accustomed to accepting engineering design and supervision by the tea company.

Factory Designing Too Special—There is a strong belief on the part of the engineer in charge of the engineering department that factory building has become too special. For the type of structure which the Great Atlantic & Pacific Tea Co. builds—bakeries, laundries, office buildings and storage warehouses—it is believed that a one-type mill building is most suitable. The tea company has tried building special buildings for special uses, but finds that that particular structure is useless if it is desired during the term of the lease to put it to other use. For instance, it has built bakeries according to the plan prescribed by modern architectural and structural notions and finds them no more efficient than an ordinary mill type building with some slight interior changes to meet the necessities of baking machinery layout. The tea company's practice therefore has resolved itself into a one-type structure with minor interior changes to meet special requirements. With this one-type structure there is possible a wide flexibility in the use of factory space.

Not only does the engineering department supervise engineering work in connection with new construction and maintenance, but it also acts as the realty agent for the company and makes appraisals upon existing property and that which it is contemplated shall be purchased. It supervises all the physical property except that included in the small retail stores. It acts as a purchasing department for any equipment that demands a special contract and specifications. Anything that has acquired a general use and which has thus become standardized and can be purchased on order is handled by the purchasing department.

Conclusions—In conclusion, *Engineering News-Record* finds a growing tendency on the part of large industries to do their own engineering and construction work. Obviously, this means that industries which heretofore may have been lightly considered as buyers of construction materials and equipment actually make such purchases aggregating many millions of dollars yearly. Also, one often finds in these engineering offices staffs which approximate those maintained by consulting engineers.

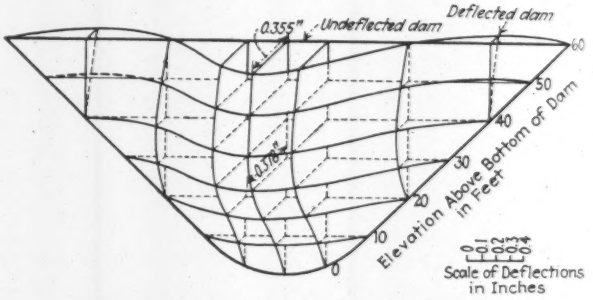
With the growing tendency of industry to employ technical graduates as non-technical employees goes the greater advantage and opportunity a young man has for following engineering work in the plant itself. Obviously, there is a great opportunity for engineers interested in manufacturing processes to combine the two personal interests to a greater advantage than would obtain if either were followed exclusively.

Experimental Arch Dam Under Test Shows Anomalous Distortion

A PRELIMINARY statement on the results of tests of the Stevenson Creek experimental arch dam have just been reported to Engineering Foundation. Interesting results are indicated by the statement and the accompanying plot of deflections under full head (60 ft.), reproduced in the adjoining sketch.

The dam was completed early in June, the last concrete being placed on June 4 and the last wooden forms being removed June 10. The structure was kept wet during and after construction by small streams of water trickling down the faces except during test measurements and during a special one-week drying period for observation. The dam is described as being a highly satisfactory "specimen," accurate in shape and dimensions and free from objectionable defects. Strain and deflection measurements turned out to be highly satisfactory and precise and checked each other well. The deflections were measured with an error generally not over 1/2,000 in.

Under full head of water behind the dam the rock



ISOMETRIC PLOTTING OF DEFLECTIONS OF STEVENSON CREEK DAM

Deflections shown to exaggerated scale on developed vertical face, looking upstream. Measurements made Sept. 18, 1926, under 60 ft. head of water, or full reservoir.

abutments were spread by about 0.03 in. (measured at the 18-ft. and 33-ft. levels). The rock under the foundation moved downstream by about 0.001 in., measured consistently in successive tests. A horizontal crack opened between the upstream edge of the base and the rock, about at the center line, when the head of water reached 30 ft., and later this crack measured 0.04 in. (all measurements here were made by an electrical-resistance instrument).

Cracks in the dam itself began to develop when the head of water reached 50 ft., first a vertical center-line crack extending all the way through from downstream to upstream face, extending from the top down to about El. 49 and later to El. 41. With full 60-ft. head another crack appeared on the vertical center line, extending upward from the foundation about 9 ft. and later to a height of about 13 ft. In both cases the strain-gage readings jumped when the crack formed, giving notice of its occurrence. The measured tensile stresses just before the formation of the crack were about 300 lb. per sq.in. in the case of the upper crack and about 570 lb. per sq.in. in the case of the lower crack (stresses calculated from strains by using a modulus of 4,000,000 lb. per sq.in.).

Leakage through the dam or around the dam is described as "extremely little." There has been some ap-

pearance of moisture around the downstream ends of the bolts which pass through the dam, originally serving to hold the forms together. Under a head of 50 ft., a small moist patch appeared at a construction joint 15 ft. above the base. By the time the dam was full another joint 5 ft. higher had enough seepage to wet an area 7x4 ft., and smaller patches appeared at a similar joint 55 ft. above the base. Some slight leakage also occurred around the ends of the dam, most of it through fissures entirely away from the dam. At 50-ft. head the total leakage was estimated at about 6 gal. per minute and under 60-ft. head "considerably larger," but only a slight leakage came through the dam itself.

At present the reservoir is empty and will presumably remain so for several months, but sprinkler pipes keep both faces of the dam wet. Detail analysis of the field records is now in progress.

Bermuda Damaged by Tropical Hurricane

By F. E. Barnes
Building Valuation Engineer, New York Central Lines, New York

BERMUDA was visited by a hurricane on Oct. 22 which did considerable damage to crops and buildings on the island. There was no loss of life on the island, but two ships were capsized in the near vicinity: a 9,500-ton oil tanker having a crew of 35 men, 22 of whom were lost, and a British torpedo boat destroyer with a crew of 103 men, 85 of whom were lost.

The writer was on the "Fort St. George" of the Furness Bermuda Line approaching the island. At 7.30 a.m., when the storm broke, we were in plain sight of Bermuda, but as a safe landing could not be made in such a gale the boat went about and headed into the storm. Twelve hours later when the storm ceased we were about fifty miles off shore. We then turned back and about 10 p.m. the lights of Bermuda were in plain sight, but the water still being very rough we remained outside until daylight Saturday morning, when we were able to make a safe landing. Captain Davis, who was in charge of the "Fort St. George," deserves a lot of credit for the fine way in which he handled the boat in the storm.

Some idea can be obtained of the strength of the storm by what it did to a 9,000-ton lighter anchored in the harbor with two anchors. The links of the anchor chains were 3 ft. long and were made of 4-in. diameter iron each link weighing 256 lb. This lighter parted both the chains and went aground.

The United States government had furnished Bermuda for at least two days in advance of the storm with warnings that such a storm was to be expected. This may account for the light loss to shipping.

Type of Storm—The storm was of the usual cyclonic type. In the forenoon on the island the wind was from the south, and blew in that direction until about noon with a constantly falling barometer, the reading at noon being 28. There was then a dead calm, indicating that the center of the storm crossed directly over the island. The sun appeared and unfortunately many people thought that the storm was over, some leaving their homes and going to their work. In about 20 minutes the wind started up again from the opposite direction or from the north, and most of the damage to the island occurred during the next half hour.

The velocity of the wind could only be approximately determined because the official Weather Bureau gage registered up to a velocity of 114 miles per hour and then gave way. It was estimated, however, by those who are familiar with such storms that the velocity was somewhere from 120 to 130 miles per hour at times.

Damage to Structures—Damage on the island consisted largely in uprooting trees, destroying much of the shrubbery, practically wiping out the banana orchards, and unroofing a large number of buildings.

Two buildings in Hamilton were blown down, a theater building and a lodge house. In the main the buildings in Bermuda were able to stand the storm so far as the walls were concerned. Practically all buildings are built of local stone, of coral formation, which when it first comes from the quarry is so soft it is cut with crosscut saws into blocks approximately 1 x 2 ft. by 8 in. thick. These blocks are laid up very much as we lay brick, making a wall about 12 in. thick. The walls are then plastered on the outside and inside, giving the appearance of a concrete house. This construction is very substantial and is able to withstand such tropical hurricanes as the one here described. The roofs of these buildings are almost universally made by sawing the same stone into slabs 1¼ to 1½ in. thick, and laying them up as shingles are laid, the pitch of the roof being rather low. They are then plastered with waterproof plaster, which makes them a monolith.

Such a roof could scarcely be injured by any amount of wind from the outside. The injury, however, was caused chiefly from the inside. In the height of the storm many windows and doors were blown open on the windward side. This did little or no damage if precaution had been taken to keep windows and doors open on the lee side, but in case a house was fully closed on the lee the internal pressure immediately became the full pressure of the wind, and although these roofs could not weigh less than 20 lb. per sq.ft. and perhaps in many cases 30 lb., they were lifted on the lee side of the house and torn to pieces and destroyed. No doubt there was a partial vacuum formed on the lee side to assist in this destruction. This occurred on many private homes, some public buildings, and at least one of the large hotels in Hamilton. The damage to buildings in the island is being rapidly repaired, and in the course of a few weeks will scarcely be seen at all.

Agricultural Damage—The damage to agriculture is somewhat more serious. Fortunately, however, the potato and onion crops are not sufficiently advanced to be materially injured. It will, however, require from a year and a half to two years to overcome the damage to the banana orchards, as the present plants are practically gone. The native trees are red cedar, and as the soil is very shallow the roots can penetrate but a few inches and the trees are easily overturned. It is difficult to say just what the agricultural damage is in dollars, but it will run into quite a large figure.

Public Services—The telephone, electric light and cable service to the United States were all put out of commission. St. John's and Hamilton, the two principal cities, were out of touch with each other, except by messenger, for a couple of days, and the entire island was cut off from other countries. Some of the hotels have their own lighting systems and so were not inconvenienced but the streets of both cities were in darkness for two or three nights. These difficulties, however, were soon overcome and within a week everything was moving along on the island much the same as before the storm.

Municipal Engineering Problems and Practice

Annual Convention of American Society for Municipal Improvements Considers Seventy Papers and Committee Reports on Paving, City Planning, Finance, Recreation and Sanitation

PAVING and allied matters dominated the proceedings of the convention of the American Society for Municipal Improvements, held at Washington, D. C., last week. Of 70 papers and committee reports on a heavily loaded program, more than a third had to do with paving materials, specifications, and construction. The majority of the 70 items on the program were committee reports, mostly perfunctory, but there were nearly 30 technical papers listed.

Broadly, the proceedings were grouped under four heads: Paving; city planning; sanitation; committee reports. At the Tuesday afternoon session, 31 committee reports were scheduled, these being in addition to other reports scattered through the program. All these 31 reports went forward to the evening session which had been left free for holdovers, the morning and afternoon sessions being required to clear up the 16 entries on the morning program. Attendance at the morning session was good but slumped and continued light thereafter. Such committee reports as were ordered to letter ballot after having been "approved" by the convention were acted upon by a mere handful of members—but as these reports had been before the society a year or more for discussion and amendment the designation "approved" was more significant than would appear by the preponderance of empty chairs when they were sent to letter ballot.

The business proceedings of the convention are noted on p. 846. The following notes are based on technical papers and committee reports thought to be of most general interest.

Paving and Other Street Topics—Of several papers on concrete pavements, the first was by H. Eltinge Breed, consulting highway engineer, New York City. The considerable lead in yardage of concrete pavements on so-called country roads as compared with city streets was attributed in large part to traffic interruption in city streets incident to putting down concrete and giving it time to cure. Mr. Breed suggested that some of the things that might be done to lessen this traffic interruption are the use of quick-setting cements, low water-content cement, and chemical accelerants. Commenting on this paper, President Hatton remarked that this year alumina cement had been used on Milwaukee pavements at railway intersections. He added that the results were surprising both as to the quickness of the setting (some two days) and as to cost, and added that manufacturers could not expect this cement to be used extensively at its present high price.

The second paper on concrete pavements was by A. R. Hirst, New York City, who, among other things, said that he had come to the conclusion that there is no such thing as a permanent roadway surface. He laid stress on the lag between technical knowledge and actual practice in construction of concrete pavements, and on the need for better inspection, especially in municipal work. He also said that probably too much cement is being used in many concrete pavements and added that in his opinion a mortar of 1:2 is sufficient and that then the more aggregate that can be worked in, the better. Pavement base as well as wearing surface must be built as a structure. Not one specification in ten, Mr. Hirst thought, calls for the curing of the base of concrete pavements.

In a paper on tests of brick pavements, J. F. Pauls, associate highway engineer, U. S. Bureau of Public Roads, reviewed the recent government tests of thin brick at Arlington, Va. These tests, Mr. Pauls said, indicate that 2½-in. brick, of the quality used, when properly supported will carry heavy traffic and that 2-in. under the same conditions will carry light traffic. Reduction in thickness was accompanied by a reduction in the factor of safety and demands a high quality of brick and also control of traffic over it.

Thomas E. Collins, city engineer, Elizabeth, N. J., in a paper on telford pavements, said that in the city named over 150,000 sq.yd. of telford have been resurfaced since 1914. Complementary to a paper read before the society last year on repair costs of city pavements by R. H. Simpson, of Columbus, Ohio, a paper on repair costs of rural pavements was presented by Frank A. Thomas, city engineer of Euclid, Ohio, and former paving engineer of Cuyahoga County, Ohio. This paper included numerous graphs and other data on repair work in Cuyahoga County during the past thirty years, the earlier pavements in question being all of brick, which are still far in the lead in yardage, the very earliest being 4-in. brick on a 1-in. sand bed resting on a 6-in. broken stone base, the pavement width being only 8 ft. In his concluding summary, Mr. Thomas said: "One of the surprising things brought out from this study of repair costs is the excessive repairs made in pavements of some types built since 1915. Several have had considerably more than their first cost spent in repairs, and this, too, before they had rendered ten years' service. In short, property owners needed a new pavement before the 10-year bonds on the old one had been retired." As a final summing up, Mr. Thomas said that "it behooves engineers who are designing pavements to put more of the 'repair cost' in 'first cost' instead of letting some road commissioner put it in later in 'after cost'."

At the joint session with the American Asphalt Association, the convention of which is dealt with on p. 845, there were three papers—on hot mix, black base and salvaging old pavements.

The session devoted chiefly to paving and street matters gave place to representatives of three commercial organizations. "The Importance of Care in Mechanical Handling of Bituminous Materials," was dealt with by William E. Worcester, of the Kinney Manufacturing Co.; "Rock Asphalt," by W. A. Brownfield, chief engineer, Kentucky Rock Asphalt Co., Louisville; and "Snow Loading," by J. E. Marson, of the Barber-Greene Co., Aurora, Ill. There was also a paper on snow removal at Detroit, read by John W. Reid, commissioner of public works, but prepared by a man in his department.

Small City Engineering Organizations—Included in the session devoted to paving and related matters was a paper by Harry Tucker, professor of highway engineering, North Carolina College, Raleigh, entitled "Suggested Organization of the Engineering Departments in Small Cities." This paper, the author stated, was along very much the same line as the article appearing in *Engineering News-Record*, Jan. 14, 1926, p. 76, summarizing conclusions drawn from its series of articles on "Engineering in Small Cities." In conclusion, Professor Tucker suggested that for cities of 25,000 to 26,000 people, the engineering organization might comprise a city engineer and a staff of eight men, including a building inspector, at a total salary charge of $35,000 a year. There was no discussion of this paper, which came at the close of a long session.

City Planning, Recreation and Finance—How one city has worked consistently to carry out a city plan instead of filing the plan away to gather dust was told by P. L. Brockway, city engineer, and also member and secretary of the City Plan Commission, Wichita, Kan. The plan being executed was submitted in 1922 by Harland Bartholomew, city planning consultant, St. Louis. The plan is kept constantly in mind in connection with all city improvements. No subdivision plots are allowed to be filed unless they accord with the major street plan. Before adopting plans for opening new streets, traffic counts are made in the vicinity and the zoning map is used for determining needed street widths. New bridges are made to conform to the major street plan even if existing streets each side of the bridge are as yet narrower. The practice of conference with property owners was one of the large elements of success in carrying out the street plan, toward which, Mr. Brockway said, much has been accomplished in five years.

A review of city planning as affecting the city of Washington and the District of Columbia from the time of the formation of the district until now, with particular reference to the work under way in both city and regional planning under the National Capital Park and Planning Commission, was presented by Major C. H. Brown, engineer of the commission. The commission has effected an organization and has formulated a general scheme for future action which includes parks, water supply, drainage and zoning—the last being supplementary to the District Zoning Act of Congress passed in 1920.

The relation between traffic movements and pavement design was the subject of a paper by Edwin A. Fisher, city consulting engineer, Rochester, N. Y. Parking of automobiles makes former street widths too narrow on both ordinary and residence streets, while on all streets with trolley lines the advent of automobiles that naturally run faster than the trolleys calls for additional street widths. A minimum width of 8 ft. for traffic lanes, with indications that even 9 and 10 ft. are being favored by some engineers, was reported by Mr. Fisher as also the use of street crowns as flat as possible. Roadway widths of 30 ft. for two lines of traffic and two lines of parking was suggested by Mr. Fisher and six or eight traffic lines for through streets, with arterial streets as much wider as may be needed, the latter carried around instead of through the city. Traffic zoning, both one way and for the heavy traffic, was also suggested.

Under the title, "The Liberty Plan," a scheme for a superhighway from Boston to Washington, D. C., with "seaward bypasses" at various cities and with a number of long-span suspension bridges, was outlined in a paper sent by Van Ness Bates, consultant, the Metropolitan Improvement Association, Boston. The paper opened with a statement that a straight line drawn from Faneuil Hall, Boston, to the National Capitol in Washington passes near the Statue of Liberty in New York Harbor and Independence Hall in Philadelphia, and would be tributary to various roadways on or near which some 20,000,000 of people live. Two major trunk lines, for at least part of the distance, were proposed, one passing through New Haven and another through Worcester and the Bear Mountain Reservation west of the Hudson River. The plan includes a bridge 11,000 ft. long across the Narrows from Brooklyn Borough to Staten Island, New York City, with a main span of 4,200 ft. and a maximum height clearance of 235 ft. and two gigantic granite towers, the whole proposed as a New York war memorial. At the close of the reading of this paper (which was addressed chiefly to empty chairs, only 35 being present) President Hatton characterized the plan as the boldest he had ever listened to and one that may be carried out in the lifetime of some of those present but not within his.

Several papers on recreation and on municipal finance were listed on the program, but for the most part their authors were absent. Some were read by title. There was, however, a spirited address on playgrounds and other means of recreation for young and old by Eugene T. Lies, of the Playground and Recreation Association of America, Chicago.

The method of providing a sewerage system for Troy, Pa., to meet conditions incident to lack of financial ability of the borough to build sewers, was described in a paper by Henry W. Taylor, consulting engineer, New York City. Citizens subscribed to a fund to build the sewerage system. This was vested in three trustees who built the system and leased it to the city. Users of the system pay rental and the net revenue is being used to repay the subscribers to the fund for building the system.

Sanitation—Closely allied in general scope to some of the papers on municipal financing in the city planning and financing group were two papers in the sanitation group. The first of these was on "Charges for Sewage Disposal," by Samuel A. Greeley, consulting engineer, Chicago, who analyzed the problem of raising some or all of the cost of sewerage service by a charge on users—as was authorized by the Ohio Legislature in 1923 and the Pennsylvania Legislature in 1925 for municipalities in those states. As a basis for sewerage charge, Mr. Greeley suggested water consumption, the sewerage charge to be collected with the water bill. This, he thought, would tend to stop abuse of the sewerage system and waste of water. A written discussion on this paper was sent by George G. Earle, chief engineer, New Orleans Water and Sewerage Board. He stated that the general plan outlined by Mr. Greeley was one that he had advocated. In addition, Mr. Earle urged that there be municipal control of subdivision developments, so that scattered houses requiring various municipal services and demanding extensions that run into enormous sums would be lessened. A prac-

tical application of charging for sewerage as well as for water service was outlined in a paper on the Washington Suburban Sanitary District by Robert B. Morse, chief engineer. This district now has 200 miles of water mains and 150 miles of sewers. Fixed charges for both water and sewerage are met by (1) a small general tax, (2) benefit (front-foot) assessments and (3) a maintenance charge to consumers.

Papers on separate sludge digestion were presented by J. Donohue, consulting engineer, Sheboygan, Wis., and Willem Rudolfs, New Brunswick, N. J. Mr. Donohue treated the subject both generally and with special reference to the separate sludge digestion plant that has been in operation at Hartford, Wis., for some months past, and the new plant at Antigo, Wis., that was to be placed in operation Nov. 16. Dr. Rudolfs dealt with experiments in the laboratory of the New Jersey Experiment Station and working-scale experiments at the joint disposal works of Plainfield and other New Jersey communities.

Studies of the deterioration of concrete surfaces, going quite extensively into the chemistry of the subject, were reviewed by John R. Baylis, formerly chemist at the Baltimore water filtration plant and now in the Water Safety Division, Chicago. Mr. Baylis suggested that where cement-lined pipes are subjected to water that is naturally highly corrosive the water should be treated to reduce its corrosibility.

Under the heading "The Need of Metropolitan Utility Districts," V. Bernard Siems, city water engineer, Baltimore Md., advocated that districts based on natural watershed boundaries be formed for the benefit of metropolitan areas. Under the plan which he had in mind "giant district utilities would conserve the natural utility resources through the definite allocation of specific streams for water and power sources, and the scientific development of those sources to serve a demand which, under the present conditions, is unknown, but which could be accurately gaged in the case of established utility districts, where the extent of the territory to be ultimately served, its character of development, and factors determining the required demands, would be possible of accurate calculation." The author had in mind particularly the encroachment of water power developments upon sources of water supply that would be badly needed in the future. Private rather than public ownership and operation of utilities was favored by Mr. Siems.

Committee Reports — As already stated, most of the committee reports were perfunctory in character. A few reports were submitted for final adoption and sending to letter ballot, embracing either reports quite recently completed or those which had been before the society for some years with amendments from time to time, but that had never been sent to ballot, as well as amendments to some reports already adopted. For the committee on stone block pavements, Julius Adler, Philadelphia, reported that the society adopted specifications in 1920 that had since been amended somewhat. The amendments had been included in a redraft, together with some condensation. The specifications as they now stand were sent to letter ballot. The committee on contract forms, working in co-operation with a like committee of the Associated General Contractors, reported specifications that had been agreed upon jointly (approved by the A.G.C. last March). These were ordered sent to letter ballot, as were also specifications for sewers and for sidewalks and curbs, the latter, however, merely embodying slight changes in the specifications adopted in 1920.

There was a long list of reports by representatives on various joint committees. Among these a report on "Design for 7-in. Plain Girder Rails for Use in Track Work," A.E.S.C. Project Designations E-8 and E-9, was approved by the members of the A.S.M.I. present and ordered sent to letter ballot.

Maryland Tornado Wrecks Well-Built Country Schoolhouse

Wind Displays Great Violence at La Plata—Brick Pier Carried Far Away—Patches of Top Soil Eroded

BY NOLAN D. MITCHELL
Structural Engineer, Bureau of Standards; Clarendon, Va.

A TORNADO swept through Charles County, Maryland, on the afternoon of Nov. 9, with disastrous results. The property damage which it did was not very great, but the loss of life was large, especially in

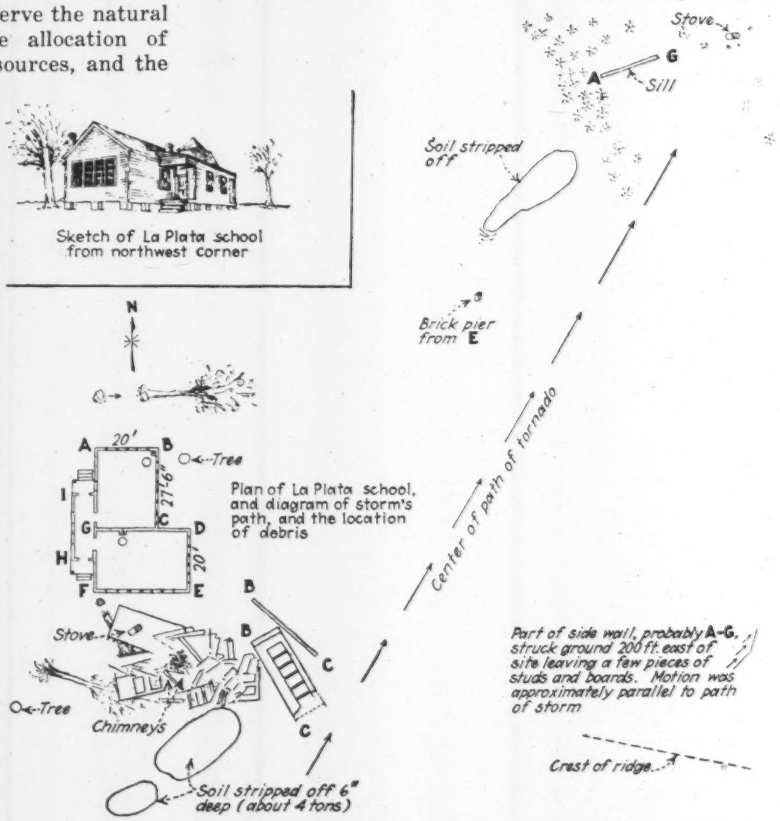


FIG. 1—SKETCH OF SCHOOLHOUSE, AND LOCATION PLAN OF WRECKAGE AND STORM PATH

view of the small number of persons in its path. Seventeen persons were killed; of these 15 were pupils in the elementary school of La Plata, a small town 30 mi. south of Washington, D. C.

The two-room frame schoolhouse was old; some remodeling had been done within the last two years, but without greatly disturbing the timber frame, which was well made. The sills were of 6x8-in. white oak timbers mortised and tenoned at all corners. The corner posts were of 4x6-in. yellow pine and were braced with 4x6-in. white oak diagonal braces. The diagonal braces were well spiked with 20d. nails. The studs, which were generally set 16 in. on centers, were of 2x4-in. rough sawn pine. The outside weatherboarding was nailed directly to the studs. The interior, originally plastered on wood lath, had had a considerable part of the plastering removed and the walls and overhead ceiled with ½-in. matched and beaded ceiling. The house rested on brick and concrete piers but was not anchored to them. At the north end the sill was 19 in. above the ground and at the south 10 in., leaving all the space under the floors open. The roof framing was of good material and had been reasonably well done.

The accompanying sketch shows the building from the northwest and gives an idea of its character. The diagrammatic plan shows the path of the storm and the direction of the motion of the building parts.

That the whirling motion of the wind was extremely violent may be judged from the fact that although the storm was traveling northeast the building moved from its foundation in a southerly direction. Every part except the west sill of the vestibule was swept clear from the site. Approximately one-third was carried entirely away. Only about one-third of the floor of one room remained on the floor joists. The greater part of the two east wall sections held together. The section *B-C* and the sill on which it rested were about 65 ft. from their original location. The sill from the opposite side of the room was found 260 ft. in a northeasterly direction, while one of the walls, probably *A-G*, had fallen some 200 ft. east from the building, and near the eastern edge of the tornado path.

In the northeast corner of the building stood a chimney; this fell approximately 60 ft. south of its original location and very near where the central chimney fell. A brick foundation pier 8x17 in., four courses high, was lifted from the southeast corner of the building and deposited 130 ft. to the northeast. Boards and timbers were scattered for miles. A 12-ft. length of ceiling board, five pieces of wainscot and about 120 sq.ft. of roofing were found eleven miles away.

While the open space under the floor and the lack of anchorage may have contributed to the destruction of the building it is doubtful whether any of the ordinary constructions would have stood. If the brick pier were carried in sustained flight, and there is good evidence that it was, the force that sustained it could not have been much below 75 lb. per sq.ft.

Another indication of the tremendous wind forces is in the lifting and transporting of several tons of earth from fairly level ground, as indicated in the sketch. Probably the raising of the earth was started by the impact of some flying object, but once started the top soil was stripped from many square yards.

That a solid brick foundation wall would not have saved the building is demonstrated by the destruction of an old but well built farm house about 800 ft. southwest of the school site. It had a continuous brick wall foundation and well framed floor and walls, and yet it went down before the wind.

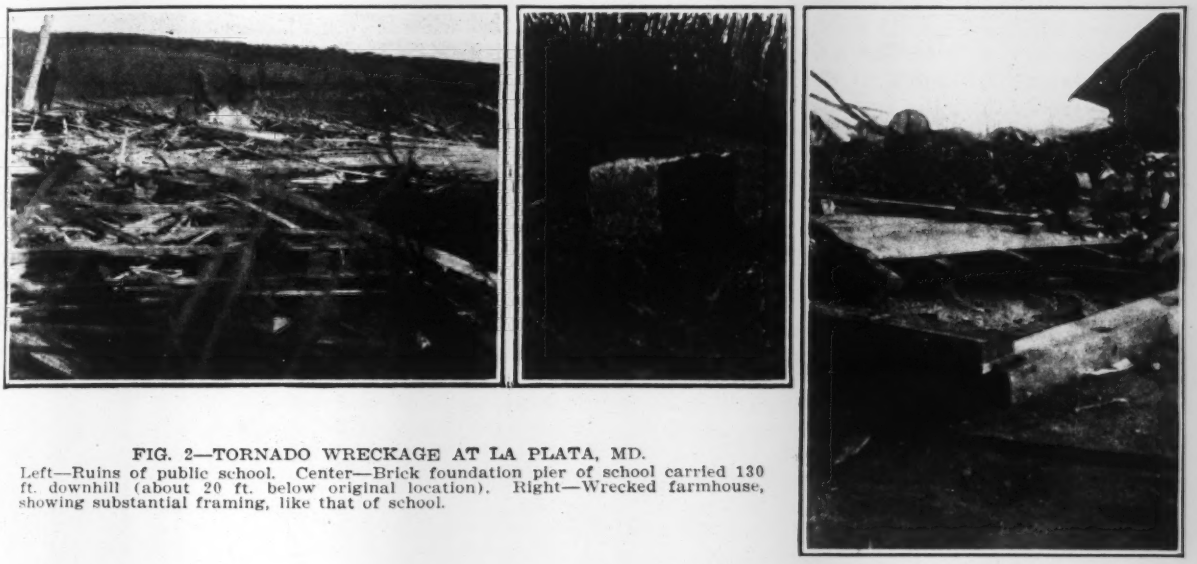


FIG. 2—TORNADO WRECKAGE AT LA PLATA, MD.
Left—Ruins of public school. Center—Brick foundation pier of school carried 130 ft. downhill (about 20 ft. below original location). Right—Wrecked farmhouse, showing substantial framing, like that of school.

Irrigation in India

Irrigated lands in India in 1925, exclusive of the Indian native states, aggregated 42,431 sq. miles, or 12.4 per cent of the total land area under crops. The total capital cost of the irrigation works, including navigable canals, is about $31,000,000, while the value of crops grown on irrigated lands is estimated at $50,000,000. In 1925, the gross revenue for irrigation works was $3,620,000 while the operating expenses were $1,343,000, giving a net return on capital of 7.29 per cent. In the Bombay presidency, the Bhandardara dam on the Pravara River works was completed to its full height of 270 ft., while the Bhatgar dam will be completed in 1927. Both of these structures are for hydro-electric power and irrigation purposes. Surveys were made for the Jalalpur project to utilize seepage water in the Jhelum River for irrigating alkaline lands.

Highway Officials Discuss Routine Topics

Program of State Highway Department Engineers Convention Confined to Discussion of Common Problems of Road Design and Upkeep—Resolutions Suggest Broader Activities

WITH a program covering a very broad range of highway topics, the convention at Pinehurst, N. C., last week of the Association of State Highway Officials developed few high spots. Traffic, maintenance, construction and design all received consideration in adequate papers and committee reports recording advancement of practice but not pointing the way to any great possibility of constructive thinking or action. In a great degree the convention proceedings reflected the condition of routine procedure, capable and intelligent but not inspirational, into which highway engineering is settling down. There is need, and the program reflected it, of the driving power of greater purposes than the perfection of construction and maintenance technique. Large tasks loom on every horizon and organization leadership in forcing attention to them did not stand out in the work done in general convention at Pinehurst.

In his presidential address Frank Page of North Carolina indicated touch with the bigger things in his comment on the need of broad and concerted thinking on traffic control in respect to loads and safety. Citing the familiar facts of road destruction by a small percentage of users, of federal court restrictions on state control of interstate traffic and of mounting accident records, the speaker urged investigation and leadership in constructive action. Again, Secretary of Agriculture William M. Jardine showed comprehension of larger purposes in his statement that of "immediate concern is the selective betterment of sections of the road system to relieve congestion, eliminate danger and generally to adjust the existing improvement to the growing needs of a still increasing traffic."

Touching on present administrative conditions Secretary Jardine announced a flat stand against county domination in state road development and for decided advance in state practices generally in federal-aid roads upkeep. He asserted that no amount of traffic study and technical research "will suffice to provide an orderly and systematic improvement of the main roads in the states which still rely upon the financial assistance of the counties to carry out the state program." Continuing he said: "Full operation of the provision of the federal highway act which aims to correct the condition has been twice deferred in federal legislation to give the states concerned time to correct their laws. There ought to be no further delay." Looking to the future also the secretary stated that there must be improvement in the maintenance of federal-aid roads. Only a few states, he said, were persistently failing to meet their maintenance obligations and then stated: "I take this opportunity to urge very seriously upon those states, which cannot themselves be satisfied with such conditions, their immediate correction. The department wishes to make clear its position that the duty to maintain roads already constructed is paramount."

Reconstruction Problems—Pavement reconstruction and the allied problem of wider roads or alternate routes were considered in four papers. P. M. Tebbs of Pennsylvania divided reconstruction problems into three: (1) Reconstruction of pavement at the end of its economic life, (2) resurfacing and widening pavements to meet increased traffic needs and (3) relocation and construction of roads badly located. In any case, a survey and economic study were necessary to determine the annual charges of the old road compared with those of a new road. Action toward adopting standard highway widths was urged. Pennsylvania laws enabled its highway department to establish building lines so that future widening could be carried out without building damages. In describing several examples of widening and resurfacing the fact was cited that in case of certain sub-soils, generally sand, where half the width was built while the other half carried traffic, the jar of vehicles over the old rough half-road might crack the green concrete on the new half. Again in contracting resurfacing, the rough surface made it difficult to estimate quantities of resurfacing. A plan was to call for square yard prices for a minimum thickness and then cubic yard prices for additional yardage. A difficulty was that contractors tended to put excessive prices on the cubic-yard material. In concrete resurfacing the minimum of 4 in. was set as the least practicable depth.

Discussing California practice, R. M. Morton stated that every poor location should be relocated in reconstruction. For reconstruction also a minimum right-of-way of 80 to 100 ft. was secured. The standard traffic lane was 10 ft. In all relocation standards of alignment comparable with those of the best railway practice were insisted upon. For widening in excess of 30 ft. the cost was assessed against the abutting property. Old concrete roads were in many cases being resurfaced with asphalt and widened with asphalt concrete strips or shoulders. There had been no breaking away of the shoulders developing surface cracks along the old concrete slab edges. Their requirements for bridge widths were 24 ft. for 25-ft. roads and 30 to 40 ft. for wider roads. The minimum concrete resurfacing depth was 6 in.

The question whether to widen roads or to build alternate routes was discussed by A. W. Dean of Massachusetts and F. T. Sheets of Illinois. Mr. Dean considered that each method had its field. Assuming a 10-ft. traffic lane, the practice, he said, had been to consider only even multiples of this as advisable. He held that often the three-lane (30-ft.) road had a rightful place. In many places the heavy traffic was one way in the morning and the opposite way at night. In such cases a 30-ft. road would handle virtually twice the traffic of a 20-ft. road and thus meet all demands. A road, he felt, should be designed for daily peak loads but not for yearly peaks. Wide roads increased the difficulties at intersections. Any road 60 ft. wide should have safety isles at intersections. In general, widening was the only resort in some locations but parallel routes should be chosen wherever practicable. Mr. Sheets was pronouncedly in favor of diffusing traffic by parallel

roads wherever it could be done. Then traffic will tell which route needs widening. If two traffic lanes were inadequate he would jump to four lanes instead of to three. Any road however wide should have shoulders outside the traffic lanes for parking. On 40-ft. roads 8-ft. shoulders were being provided.

Concrete-Pavement Design—Referring to the consensus of all test evidence for the last five years as favoring the thickened-edge design, H. E. Surman, of Illinois, asked why practice had been so slow in adopting it and why the Bureau of Public Roads should continue to approve other designs. In slab design the three factors were maximum load, character of subgrade and climatic conditions. Most study had been given to the first and little to the other two. In respect to loading he urged vigorously that there should be no increase over the 8,000-lb. wheel load. Illinois, he said, had spent $150,000,000 on roads designed for this maximum and refused to contemplate endangering this investment by opening the way to heavier loadings which only a few people wanted. He thought other states should be equally insistent and that the association should put itself on record as disapproving a load increase. Another factor which he emphasized was smoothness. Fatigue and impact tests had demonstrated its exceeding importance. Referring to subgrade soils he pointed out that no practicable method of investigation had been worked out nor had any methods of treatment been determined. Both tasks should be performed. Illinois practice he said was to use no transverse joints except construction joints at ends of runs. They were expensive and they made the pavement uneven; they did not reduce cracking and their lack had not produced more than an occasional "blow-up." The rural road section was 9:6:9 in., 18 ft. wide with a 2-in. crown; the heavy-traffic section was 9:7:9 in., 20 ft. wide with a 1-in. crown so that widening to 40 ft. would not give excessive crowning. Both sections have longitudinal sheet metal deformed center joints with dowel bars and longitudinal edge bars. The 40-ft. pavement was two 20-ft. pavements side by side and had 6-ft. shoulders. Curves up to 6,000 ft. radius were superelevated and all curves were widened on the basis of passing two of the largest-size motor buses. All widening was on the inside.

In discussion, F. H. Jackson, Bureau of Public Roads, stated that 39 states now used the thick-edge slabs. In present designs over 8,000-lb. wheel loads introduced critical stresses. The safe working stress could not exceed over one-half the modulus of rupture. Regarding transverse joints, he said, regularly spaced joints were used by 30 states. In general, a balanced cross-section was had when the center depth was about 0.7 the edge depth. The thickened-edge section without center joint, at times used, seemed without justification.

Road Maintenance—The two divisions of maintenance work, (1) surface preservation and (2) preserving integrity of structure, were emphasized by R. L. Cochran of Nebraska. As the first is under the eye of the public it is likely to take an undue importance and extra effort is needed not to overlook the second duty. Maintenance, he said, has to keep safety particularly in mind and today invariably includes snow removal as an essential. Successful maintenance calls for direct state control and the patrol system. In Nebraska practice is settling down to a light-tractor one-man patrol.

Some new kinks in maintenance methods were given by A. H. Hinkle of Indiana. By combining a quick-hardening portland with the previous practice of a rich, dry mix, with coarse sand, heat and calcium chloride, he stated a patching mixture could be secured which could be thrown open to traffic in one day. On bituminous road work late in the season the lumpiness of rock asphalt due to cold was being well handled by passing the material through a regular threshing machine cylinder and concave. An improved surface had been secured on bituminous top by dragging. The mix was spread, raked and rolled and then surfaced with a steel drag. A final rolling followed the dragging.

Resolutions Adopted—Resolutions of importance on toll roads, accident prevention, federal aid, load regulation, etc., were voted.

That on toll bridges is of such wide-reaching importance that its publication in full and editorial discussion are reserved for a future issue. The other resolutions of significance were:

1. That the Sub-Committee on Traffic Control and Safety prepare a standard report form to be used by all of the states in reporting the causes of accidents on the highways, such report form to be submitted to the Executive Committee for approval and submission to the states for letter ballot, so it can be used as soon as possible.

2. That federal legislation to regulate motor trucks and buses operating as interstate common carriers be limited and provide for joint state supervision with appeal to a properly designated federal department in case state authorities do not agree.

3. That Congress pass legislation giving to the proper federal department, authority to grant to the states or their political subdivisions permits for the construction of bridges over interstate navigable streams without the necessity of a special act for each bridge.

4. That the President appoint a committee to determine the ways and means of bringing about the cooperation of the American Road Builders' Association and the American Association of State Highway Officials in the solution of the many highway problems now confronting us and in furthering the interest of the highway industry.

5. That in any state containing unappropriated public lands and non-taxable Indian lands, exceeding 5 per cent of the total area in any state in which the population does not exceed ten per square mile, the share of the United States payable on any highway which is a part of the federal system, may be increased by the Secretary of Agriculture, to any percentage up to and including the whole cost thereof.

That the limitations on payments of federal funds per mile be changed to permit equal participation by the government and the state on any project, where the following conditions exist: (a) Where topographic conditions are such that the average cost per mile exceeds $10,000, and (b) where by reason of density of population or character and volume of traffic the width of pavement to be placed should be greater than 18 ft.

That the restrictions which limit to 60 per cent of the available federal aid funds which may be expended upon the primary system in any state during any one year be eliminated.

Balch High-Head Power Project Well Under Way

Plant on Kings River, Calif., to Use 2,381-Ft. Head—Novel Penstock Features—Ultimately Eight Other Plants in the Series

THE BALCH hydro-electric development on Kings River in California during the past summer was at its peak of construction with work under way on dam, tunnel, penstock and power house. The project is the first of a series of plants to be built on this river by the San Joaquin Light & Power Corporation which has plans for developing a total head of 7,290 ft. in nine plants on two branches of the stream with a total capacity of 500,000 hp. The series of plants will involve four reservoirs, 14 dams of various types and about 40 miles of conduit, chiefly in the form of pressure tunnels.

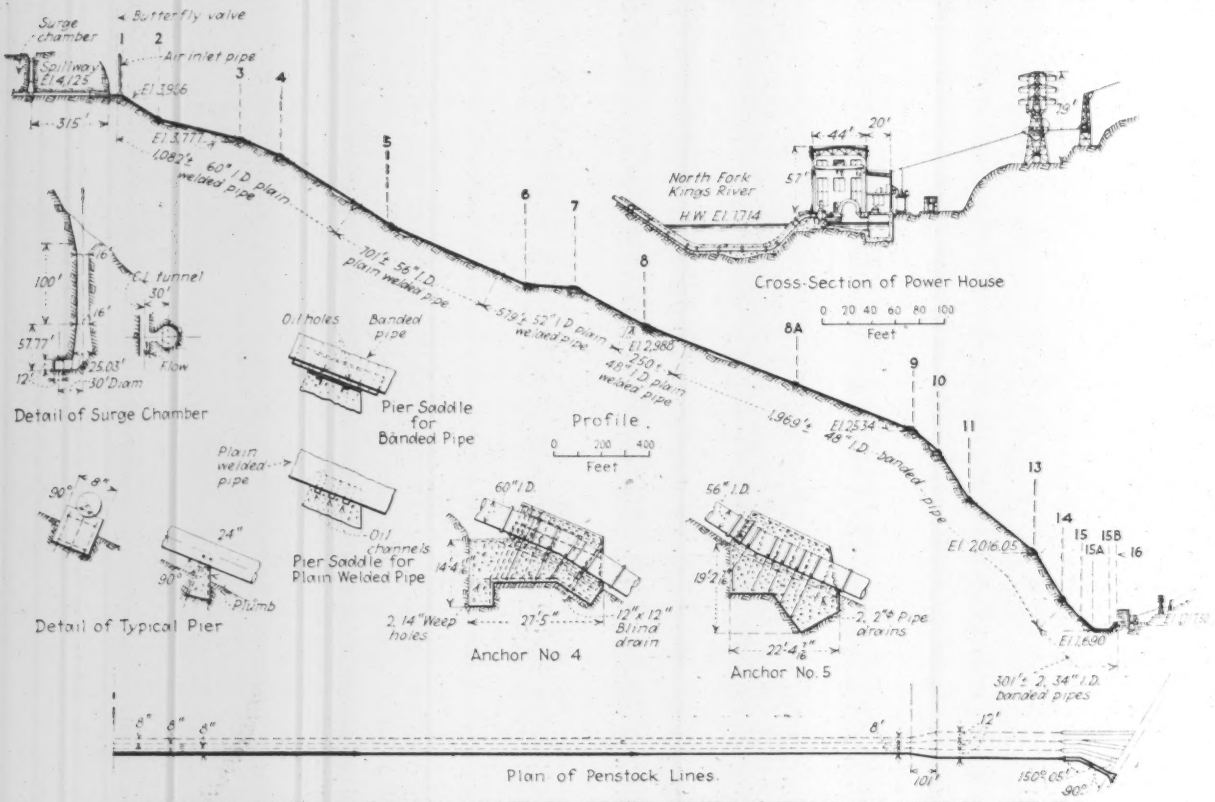
The Balch plant, scheduled for completion by the first of next year, will begin operation with a 40,000-hp. impulse wheel operating under a head of 2,243 ft. (2,381 ft. static) served by a banded penstock following an unusually steep slope at its lower end and passing under the river to reach the power house. Announcement of plans for the project appeared in *Engineering News-Record*, April 9, 1925, p. 619. Until the Bucks Creek plant of the Feather River Power Co. is completed this plant will be the highest head plant in the United States. The Bucks Creek plant will have a head of 2,552 ft.

The Kings River development was laid out well in advance so that there would not be the economic loss resultant from rush construction and hasty decisions. Preliminary work was begun in 1917; at that time this region had been hardly more than explored and triangulation surveys and thorough mapping of the territory were required. The developments will be chiefly on the north and west forks, the highest reservoir being at El. 8,170 and the discharge from the lowest plant being at El. 880 into the proposed Pine Flat irrigation reservoir.

Despite the fact that the Kings River region was very little known as late as 1917, the distance from the Balch plant to the center of the company's power system is only 39 miles, which can be spanned by transmission lines that will not be difficult to construct or maintain. The distance by road from the nearest railroad to Balch power house is 30 miles.

The most expensive part of the preparatory work was the construction of about 45 miles of roads. This road work has cost about $750,000 and includes some very difficult construction. One stretch of 20 miles of 6 per cent grade had to be built for much of its length along the face of granite rock slopes so steep and smooth that it was necessary for drillers to work from ropes that were in some instances more than 200 ft. long. The road work on this project was described in *Engineering News-Record*, April 19, 1923, p. 696.

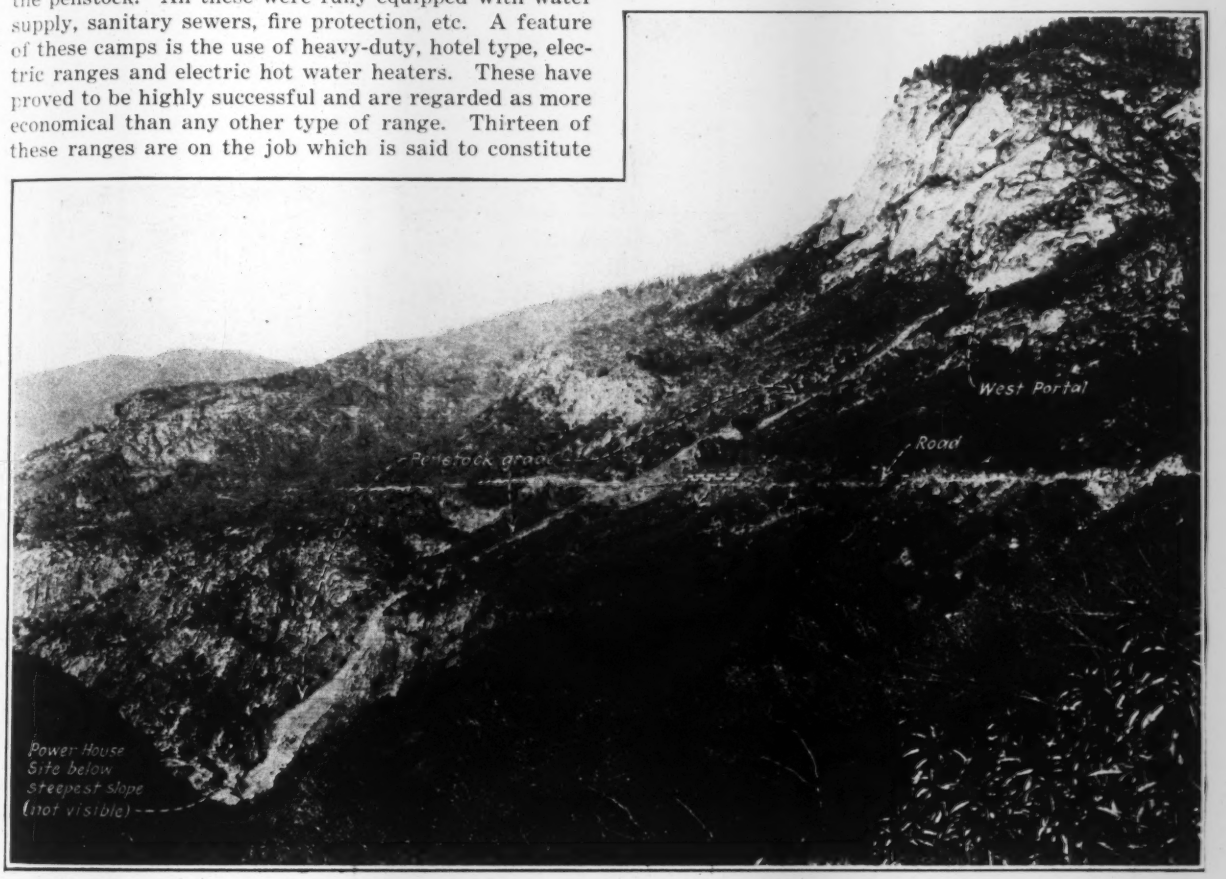
In March, 1925, authority was given to start construction on the first unit of the Balch plant and $3,764,000 was made available for the work. Only the first 40,000-hp. unit is to be installed at present; later three duplicate units are to be added to the same plant.



PLAN AND PROFILE OF BALCH PENSTOCK, POWER HOUSE SECTION AND ANCHOR DETAILS

By the first of April this year work on this development was about 30 per cent completed.

One of the first moves was to build a saw mill where it would have a downhill haul to all of the several camp sites. About 2,000,000 ft. b.m. was produced by this mill in 1925 with which the company built three tunnel camps, a penstock camp where the road crosses the penstock and a power house camp at the lower end of the penstock. All these were fully equipped with water supply, sanitary sewers, fire protection, etc. A feature of these camps is the use of heavy-duty, hotel type, electric ranges and electric hot water heaters. These have proved to be highly successful and are regarded as more economical than any other type of range. Thirteen of these ranges are on the job which is said to constitute one of the largest installations of its kind and to have greatly improved labor conditions in kitchen and dining rooms.



GENERAL VIEW SHOWING PROFILE OF PENSTOCK
Power house location is just out of sight at bottom of canyon, in left foreground. Note how slope steepens as pressure head increases.

Water is diverted into the tunnel by a simple concrete arch dam, built to a height of 60 ft. this year with provision for later raising it to 100 ft. The work done this summer included about 2,500 cu.yd. of concrete and the portion of the dam below stream bed was carried to the full thickness of the arch needed for the ultimate height. The capacity of the reservoir for the 60-ft. height will be 100 acre-ft. and this will be multiplied by twelve when the dam is raised.

Labor contracts were let for tunnel driving to two contractors, each opening up an adit and working the two headings driven from it. A fifth heading was started with company forces at West Portal which is at the top of the penstock. No camp was established at the intake end of the tunnel, as it was more economical to drive this stretch of tunnel from the upper adit toward the intake and break out at the intake portal.

The tunnel has a total length of 19,345 ft., is 12 ft. square, except for a slight arch in the roof and is figured for 720-sec.-ft. capacity. The grade is 3.3 ft. per thousand, and the coefficient n in Kutter's formula was taken as 0.035. The tunnel traverses blue and gray granite for its entire length and will not be lined. Tunnel driving was started in September, 1925, and headings met Oct. 11, 1926, well ahead of schedule. The longest stretch of tunnel to be driven between two headings is 8,600 ft.

Mucking in these tunnels is done with Conweigh mucking machines operated by 30-hp. motors on 3-ft. gage track. The drilling practice in general was to put in about 35 holes to pull a 7 to 9-ft. advance. About 40 to 50 lb. of 40 and 60 per cent dynamite was used per foot of tunnel. The contractors operated their two headings on the alternating shift basis, that is, drilling and mucking crews follow one another from one heading to the other. On this plan it was often possible to drill and shoot a round in 4 hr. and muck it out in 5 hr.

It was possible to make a very economical location for the penstock which follows a precipitous slope toward the lower end, thus giving a comparatively short length of the pipe of maximum thickness. The lower 1,100 ft. has an average incline of 45 deg. with the horizontal and the portion just above the power house reaches an angle of 58 deg. The total length from the headgate to the power house is 4,882 ft.

There are no horizontal angles in the line except those just above the power house where the penstocks branch and a wider separation is therefore required. On account of the danger that would attend blasting close to a penstock line in service, the initial excavation was made of the full width that will ultimately be required by all four lines.

The penstock supplying each unit will be a single line of pipe from the tunnel to the point near the power house where it forks. The diameter at the top is 60 in. and this decreases by 4-in. stages until a diameter of 48 in. is reached. The last 300 ft. above the power house will consist of two 34-in. lines. A 36-in. air-inlet standpipe will be placed just below anchor No. 1 and three sets of air valves are to be located at critical points in the upper 700 ft. of the line.

The road from headquarters camp to the tunnel intake intersects the penstock line at its midpoint both in distance and in elevation and a camp was accordingly located at this point as the center for distribution of materials and equipment for the penstock and the far portion of the tunnel reached from West Portal. Distribution is facilitated by means of a standard-gage incline railway extending the full length of the pipe line.

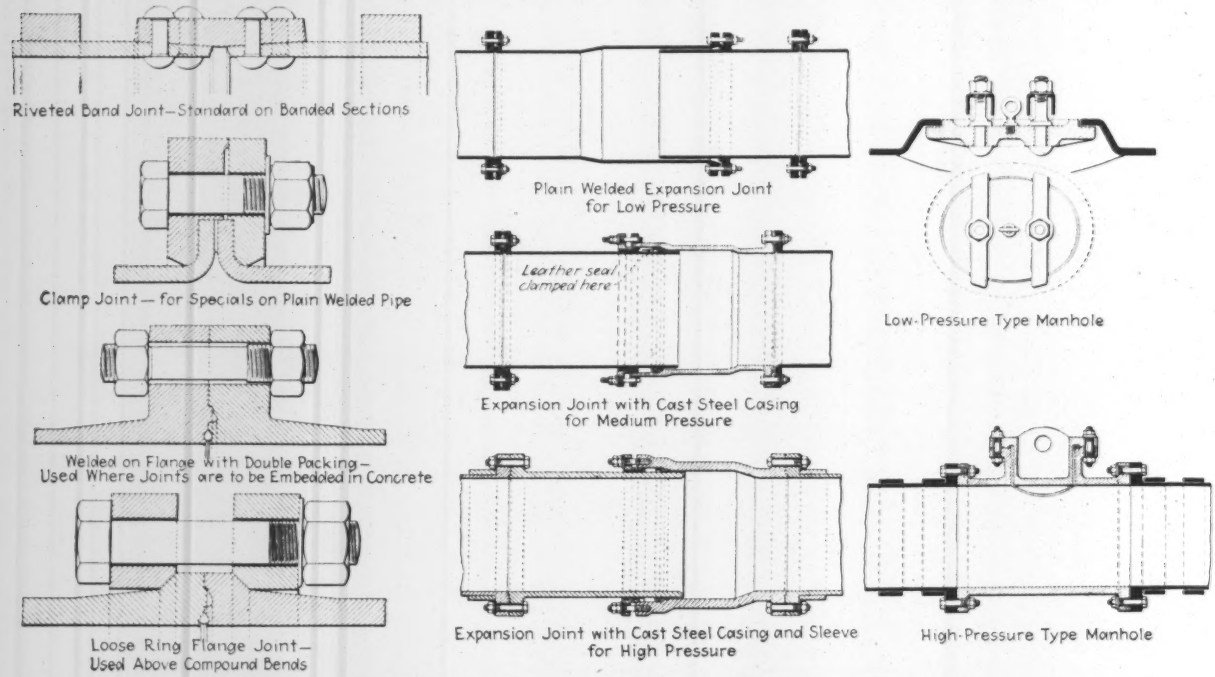
Except for a short portion of the penstock between the headgate and the portal of the tunnel which will be electrically welded, the penstock has been contracted to the Ferrum Co. of Poland. Longitudinal seams will be hammer-welded throughout the penstock. The minimum thickness in the welded plate will be $\frac{3}{8}$ in. and where the pressure head requires a plate thickness of $1\frac{7}{8}$ in. or greater, seamless steel bands will be shrunk on the plain welded core, the dimension and spacing of the bands varying with the pressure head. In general, the banded pipe will have approximately one-half the necessary cross-sectional area in the core and one-half in the bands. A typical section will have 4 x 1½-in. bands spaced 9½ in. on centers. The minimum ultimate strength of plate in the plain welded core pipes is 48,500 lb. per sq.in. and in the seamless bands, 70,000 lb. per sq.in.

Expansion joints will be used at the upper end of each run immediately below the anchor. For low pressures the expansion joints will consist of casing and sleeve over lapwelded pipe and for higher pressures the casing will be of cast steel, the sleeve being welded in the plain welded pipe and cast steel in the banded portion of the line.

The longest tangent between angle points is 1,206 ft. between anchors 8 and 9, as indicated on the accompanying profile. In order to cut down the length of this run, anchor 8-A was built about 695 ft. below anchor 8. In order to relieve anchor 9 from thrust due to expansion of the pipe above it, an expansion joint was placed above the bend. This proved to be economical by cutting down the size of anchor 9 and also the size of anchor 8-A which is thus subject to practically balanced forces due to expansion and contraction.

Riveted bump joints will be used in plate thicknesses up to 1 in., they will be single riveted up to ½ in. and double riveted for greater thicknesses. In the banded portion of the line and wherever plate thicknesses exceed 1 in., riveted band joints will be used. This joint and some of the other types of joints and specials to be used are shown in the accompanying detail drawing.

At points where flanges are necessary in connecting up bends and specials, welded-on flanges will be used. Double packing is provided where joints under pressures of 440 lb. per sq.in. or more are embedded in concrete, so that the packing may be removed if necessary from the inside of the pipe. All embedded joints will be provided with pipe drains to relieve the anchors of the possibility of hydrostatic pressure. Expansion joints, in addition to the usual packing as used in stuffing boxes, will have leather gaskets at the bottom of the space to be packed.


Riveted Band Joint—Standard on Banded Sections
Clamp Joint—for Specials on Plain Welded Pipe
Welded on Flange with Double Packing—
Used Where Joints are to be Embedded in Concrete
Loose Ring Flange Joint—
Used Above Compound Bends
Plain Welded Expansion Joint
for Low Pressure
Leather seal
clamped here
Expansion Joint with Cast Steel Casing
for Medium Pressure
Expansion Joint with Cast Steel Casing and Sleeve
for High Pressure
Low-Pressure Type Manhole
High-Pressure Type Manhole

DETAILS OF JOINTS AND SPECIALS IN THE BALCH PROJECT PENSTOCK

Each section of pipe will be tested in the shop to a pressure of 1.65 times static head on the lower end of the section. Cores of banded pipe will be tested prior to the shrinking on of bands. The pressure is to be maintained for 20 min. and the section struck with sledge hammers varying from 6 to 10 lb. in weight, depending upon the thickness of the plates. Tension tests are to be made of the welds on test pieces which are also to be subjected to cold bending tests.

Cast-steel bends will be tested in the same manner as specified for welded pipe except that the test pressures will be twice the working pressure and the hammer-blow tests will not be required. All of this testing is under the supervision of the power company's inspection engineer who was sent to the mill in Poland before manufacturing started. The first shipment of pipe arrived in San Francisco in July and construction on the penstock started immediately thereafter.

As worked out by company engineers the working

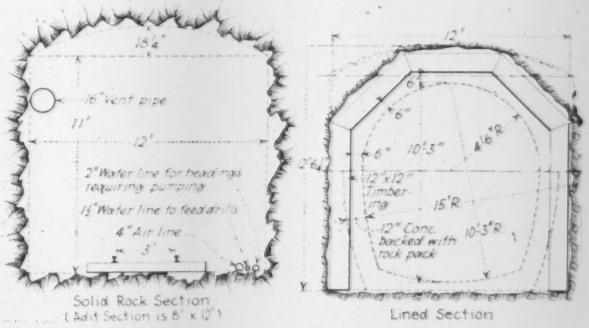
TYPICAL TUNNEL SECTION ON THE BALCH PROJECT

stresses in this line will be 10,500 lb. per sq.in. in the plain welded and 15,500 in the banded pipe. These stresses take account of the efficiency of the weld in the core pipe and include an allowance of 20 per cent pressure rise above static. Thus the maximum stress that is expected in the line with this pressure rise will be approximately equal to one-half the elastic limit of the steel.

The penstock will be supported on piers spaced 1½ pipe lengths apart up to a plate thickness of ¾ in. and for greater plate thicknesses at the center of alternate pipe sections. These piers will be reinforced on up and downstream faces and doweled to the foundation wherever possible. To relieve friction between the steel and concrete in plain pipe sections small steel channels will be placed in the saddle of the piers under the pipe and will be kept filled with heavy oil.

On the banded portion of the line the pipe sections will be provided with a steel plate or sleeve and a similar steel plate will also be provided on the saddle. The sleeve on the pipe will be perforated to allow lubrication between the two surfaces by means of oil put in between the bands of the pipe. The piers were designed assuming a coefficient of friction of 0.6 between steel and concrete which is believed to be considerably in excess of the result obtained with the design as described above.

Because the canyon where the power house was located is steep and narrow it was finally decided to



DIMENSIONS OF LINED AND UNLINED TUNNEL SECTIONS

cross the river with the penstock in order to take advantage of a better site on the far side. Three different types of crossing were considered: (1) An arch made of the penstock pipe section; (2) the pipe as a beam supported on piers; and (3) embedding the pipe in the bed of the river. This last plan was finally decided upon as safest in view of the danger of falling rocks. The rock danger was also a factor in locating the power house away from the very steep slope down which the penstock comes.

The 40,000-hp. hydraulic turbine which will be of the double, overhung impulse type, is being built by the Allis-Chalmers Manufacturing Co. There will be a single jet on each runner, 7⅛ in. in diameter at the nozzle. There will also be in the power house in each pressure line leading to the needle valve a 32-in. cast-steel gate valve operated by a hydraulic cylinder. These gate valves are designed for emergency opening or closing under full head and discharge requirements. Ordinarily, they will be for use after the plant is shut down, in case it is desired to inspect or manipulate the needle nozzles without emptying the penstock. In no case will the gates be used at partial opening to throttle the flow.

The portion of the power house built for the initial unit will be 68 ft. wide and 82 ft. long; ultimately the length will be increased to 206 ft. to house the additional units. Two 75-ton cranes, with a yoke for joint operation, are adequate for handling all parts of the equipment. The weight of the rotating unit will be 162 tons. With the arrangement of units in a power house located as in this case it was necessary to construct an artificial tailrace parallel to the river and on the side of the power house away from the river. The narrowness of the canyon made it impracticable to build operators' quarters near the plant and a site for these was selected at a point about two miles downstream where the north and west forks of the Kings River join.

The design and construction of the Balch plant are being carried out by the construction department of the San Joaquin Light & Power Corporation, H. K. Fox, superintendent of construction, R. L. Bryant, resident engineer, J. D. McDougald, general foreman, and J. W. Jourdan, designing engineer.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

New and Revised Books on Concrete

INTRODUCTION TO REINFORCED CONCRETE DESIGN—By Hale Sutherland, M. Am. Soc. C. E., Associate Professor of Structural Engineering, Massachusette Institute of Technology; and Walter W. Clifford, M. Am. Soc. C. E., Consulting Engineer, Boston. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 412; 126 line cuts; tables; appendices, with drawings. $4.

DESIGN OF CONCRETE STRUCTURES—By Leonard Church Urquhart, C. E. Professor in charge of Structural Engineering, Cornell University; and Charles Edward O'Rourke, C. E., Assistant Professor of Structural Engineering, Cornell University. Second Edition. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 501; 184 line cuts. $4.

CONCRETE DESIGNERS' MANUAL: Tables and Diagrams for the Design of Reinforced Concrete Structures—By George A. Hool, S. B., Consulting Engineer, Professor of Structural Engineering, University of Wisconsin; and Charles S. Whitney, M. C. E., Consulting Engineer, Milwaukee, Wis. Second Edition. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 329; tables, diagrams and charts. $4.

Books on concrete design seem to multiply, so that it is very hard to make comparable criticism. The new book entitled Reinforced Concrete Design, by Sutherland and Clifford, has value because the authors have clearly in mind the necessity for leading the initiate by slow stages into a problem. The method of developing design is particularly good and the illustrative problems are helpfully presented. The manner, therefore, is to be commended; the matter seems to be about the same as in the other texts.

Concrete theory and practice have not changed much since the first edition of Urquhart and O'Rourke's Design of Concrete Structures was issued, but the authors in the second edition have taken cognizance of such changes as have occurred. These have caused a more complete reference to the modern proportioning theories, a reconsideration of the column design problems to allow space for the 1924 Joint Committee rules and an extension of the treatment of the rigid frame. The book is well supplied with problems, diagrams and illustrative methods of design and therefore serves admirably as a text.

The first edition of Hool and Whitney's Concrete Designers' Manual was unique in that it brought together under the same cover a complete set of tables and diagrams for designing concrete structures. Since the making of such tables and diagrams is almost the first step the concrete designer takes, the supplying of them already made is a useful service. The second edition amplifies the first with the means for solution of a number of new designing problems.

Engineer Rows Down Columbia River

THE COLUMBIA UNVEILED: Being the Story of a Trip, Alone, In a Rowboat, from the Source to the Mouth of the Columbia River, together with a Full Description of the Country Traversed, and the Rapids Battled—By M. J. Lorraine, C.E., M. Am. Soc. C. E. Alhambra, Calif.: Published by the Author. Cloth; 5x7 in.; pp. 446; numerous illustrations. $3.50.

It was on his sixty-seventh birthday, while on a survey for a dam near Los Angeles that M. J. Lorraine, a member of the American Society of Civil Engineers, decided on a trip down the entire length of the Columbia River. Soon afterwards he arrived at Canal Flat, B. C., a railway station on the Canadian Pacific. There he made a rowboat from his own design, and from there he started on his 1,264-mile trip in the early summer of 1921. The main incidents of the voyage, with much information about the river and the few cities and many hamlets on its banks, the natural resources of the country traversed, and the engineering works and possibilities along the route are told in The Columbia Unveiled, published in 1924 but just brought to our attention by its author. With few mishaps, none of which materially injured the navigator or his craft, Mr. Lorraine shot numerous rapids. He made but few portages. Practically all the time he was alone. The trip was an achievement to be proud of. The book is well illustrated, chiefly from photographs.

Glorifying the Current Meter

REVIEWED BY I. GUTMANN
Research Engineer, Sanborn & Bogert, Consulting Engineers, New York City

DER GENAUIGKEITSGRAD VON FLÜGELMESSUNGEN BEI WASSERKRAFTANLAGEN—By Prof. Dr.-Ing. A. Staus. Berlin; Julius Springer. Paper; 6x9 in.; pp. 35; 19 halftones, line cuts and tables. 2.4 reichmarks in Germany.

In this brilliantly written pamphlet Dr. Staus discusses the precision of current meter gagings of canals and closed conduits. It is not a manual of instructions or descriptions but a critical review of instruments and methods of measurement and computation pointing out potential errors and their bearing on the precision of the final result.

Fully half of the pamphlet is devoted to a discussion of the current meter of the propeller type—more specifically the latest models of the Ott current meter. The author gives interesting curves showing the degree of precision with which the Ott meter registers the axial component of oblique currents; also a series of curves showing the interference of channel walls. The last chapter reviews recent experiments by Kuntschen, Streiff (of Jackson, Mich.) and others in which gagings by the Ott meter were compared with simultaneous measurements made with weir, diaphragm, chemical solution and current meters of other makes. The comparison was almost invariably in favor of the Ott current meter.

The author concludes that the gaging of artificial channels with current meters of the propeller type is simpler and less expensive than chemical gaging or measuring by weir or diaphragm, and is not surpassed in precision by any of these methods. He ventures to predict that gaging with the current meter of the propeller type, which is accepted practice in Europe, will not be superseded by these other methods.

The Price current meter, the official meter of the U. S. Geological Survey, is attacked and given no quarter: Designed on the principle of the Robinson anemometer, it does not register the proper axial component of the stream. Its reaction is not restricted to the forward axial component of flow as in an effective propeller meter, and the result is that the maximum intensity of the current is registered irrespective of direction, axial or non-axial, forward or backward. The

Price current meter is pronounced faulty in principle of construction, unreliable and obsolete—in short, it should be relegated to a museum of curiosities.

This is serious criticism since most of the stream gaging on our planet has been done with the Price meter.

It may be noted in passing that the deficiencies as well as the merits of the Price meter have been appreciated in this country for some time. (See "Defects in Current Meters and a New Design" by S. Fortier and E. J. Hoff of the U. S. Department of Agriculture, *Engineering News-Record*, Dec. 11, 1920, p. 923.) Dr. Staus is apparently not aware of our growing discontent with the Price meter. As a matter of fact, another government institution in the United States, the Department of Agriculture, is retiring the Price meter, supplanting it with its own Hoff current meter, which is also of the propeller type, resembles the Ott meter, and possibly surpasses it in one or two respects.

The pamphlet ends with a valuable bibliographic appendix.

From a British Viewpoint

WATERWORKS ADMINISTRATION: Being a Practical Guide to the Solution of the Many Problems to be met with in the Business Management of a Public Water Supply Undertaking, and containing some Suggestions for the Amendment of Waterworks Law—By W. H. Parsons, Chief Revenue Officer, Secretary's Department, City of Birmingham Water Undertaking. London (England): P. S. King & Son, Ltd. Cloth; 6x9 in.; pp. 309; some charts and appendices. 18s. in England.

Wide-awake engineers and operators of water-works in any part of the world should find in this volume much that will interest them and, despite differing conditions outside of Great Britain, many suggestions of value. For water-works men in Great Britain and such other parts of the British Empire as follow British practice, the volume should be of great value, for its admirably written summary of statutory and central government administrative requirements, with clear outlines of practice in certain fields of water-works administration, and particularly for its many pertinent suggestions for needed reforms. The latter relate largely to a much needed consolidation of water-works parliamentary legislation, the main body of which goes back to 1847 and 1863 so far as general powers are concerned and to 1875 and 1878 as regards public health.

The volume is chiefly concerned with the relations between "water undertakings" (meaning both municipally and privately owned water-works) and water consumers. That is, it has to do with water-main extensions and house-service connections, inspection of house fittings, charges for water, and the whole machinery of collecting water charges, including billing and bookkeeping, "internal audit" and statistical summaries, the latter designed chiefly to show revenue from different classes of service for the purpose of throwing light on possible needed revisions in water rates.

The book is based on 30 years of "experience in a large undertaking covering the whole range of water-works administration, combined with some opportunities of inquiring into the system and practice followed by other undertakings." Apparently, during the period named the author has been connected with the Birmingham water-works. He feels strongly a need for uniformity in water-works practice. The British basis for water charges, laid down in the old parliamentary acts, is "ability to pay." This principle relates primarily to water supplies for "domestic" purposes, as conceived many decades ago when domestic water supply was limited almost wholly to water delivered through a single faucet. It is largely because of this that there is so generally a separate charge in England for bathtubs and water closets. One of the reforms that the author strongly urges is that the "domestic" rates or the charge based on "ratable value" include a charge for baths and water closets wherever the financial condition of the "undertaking" will permit.

The term "ratable value" means the value of property as assessed for local "rates," or, as we should say, taxes. As nearly as can be expressed very briefly, "ratable value" and "rental value" are the same in England. In Birmingham, the annual water rental ranges from 10s. for property with a ratable value of £5 per annum to £10 12s. for a ratable value of £101 and £3 1s. 2d. for a ratable value of £301, with corresponding percentages of ratable value of 10, 10.5 and 10.33. In Sheffield, the corresponding annual water charge is 10s. 2d., £4 18s. 2 d., £7 11s. 6d., the percentages being 10.17, 4.86, 2.52. (In both cases a varying number of baths and water closets are included.)

It is largely because of such disparities that the author urges more uniformity in water-works administration. He stands squarely for having the water rate cover the cost of the water service, but throughout the whole volume there is scarcely a hint at a scientific basis of rate making, as conceived by American engineers, water-works officials and the various state utility commissions which control the rates charged by private water companies. Nor does the volume contain anything material as to a proper basis for dividing charges for water service between the municipality and private consumers. It is almost equally silent as to anything that could be called a scientific basis of meter charges, but does suggest that "the average revenue from measured supplies should be approximately 25 per cent higher per 1,000 gal. than for unmeasured supplies." This difference is designed to equalize certain stated differences in unmetered and metered water and to make trade supplies yield a profit.

In a suggested model scheme of rates for water supply, the author proposes that "water for domestic purposes in a dwelling house or part of a house occupied as a separate tenement shall be at the rate of 10 per cent per annum on the ratable value of the premises supplied, but the minimum charge . . . shall be 10s. per annum." If baths are charged extra, then he proposes that the charge increase with the ratable value.

For metered supplies (virtually only water supplied for trade purposes), the author proposes that (1) there be no meter rental and (2) that there be minimum quarterly charges, based upon the size of meters, from ¾-in. up. Subject to the minima for the various sized meters, the meter charge itself would be on a four-slide (five different rate) basis. In American units, the meter rate would start at about 30c. per 1,000 gal. for the first 300,000 U. S. gal. per quarter and would fall to about 20c. per 1,000 U. S. gal. for anything in excess of 1.2 U. S. m.g. quarterly.

The sections of the book dealing with administrative methods promise to be more useful, this side of the Atlantic, than those on rates, although the discussion on rates will appeal to those who like to study differences between countries and their reason.

The style of the author and the typography and press-work increase the pleasure of reading the book, which is a notable contribution to water-works literature.

Applying Safety Measures

INDUSTRIAL SAFETY ORGANIZATION—By Lewis A. DeBlois, Director, Safety Engineering Division, National Bureau of Casualty and Surety Underwriters, Past President, National Safety Council; Formerly Safety Engineer, E. I. DuPont de Nemours & Co. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 278. $4.

Industrial accidents in many plants have been materially reduced in late years, not by waving a magic wand but by the functioning of a so-called safety department based upon sound principles and above all having the confidence and support of the management. The book noted here has been written for "industrial executives, the engineering fraternity and the safety engineers." It gives a clear understanding of the safety movement, its basic requirements, present status, and future possibility. The position of the safety engineer in the industrial organization, his obligations and the methods by which he can bring about a reduction in industrial accidents are outlined in a practical manner. Stimulating and maintaining the interest of the workmen are essential to any accident prevention plan and methods that have proven successful in this connection are outlined.

The safety engineer in working out his own plan must at the same time consider the state and insurance requirements. The procedure in determining what these are and how they should be administered is given. Safety appliances that are available and report forms that have been used are described and illustrated. The book should prove valuable for reference as well as providing interesting and stimulating reading about a most important aspect of present industrial management.

Translation of Belluzzo's Steam Turbines

STEAM TURBINES—By Giuseppe Belluzzo, Professor of the Polytechnic, Milan; Present Minister for National Economy of the National Fascist Government of Italy; Translated by Engr. Captain A. G. Bremner, O.B.E., R.N. London: Charles Griffin & Company, Ltd.; Philadelphia: J. B. Lippincott Co. 1926. Cloth; 6x9 in.; pp. 732; 2 plates, 34 folding and 716 other illustrations. $17.50.

In making available to those who do not read Italian Professor Belluzzo's extensive treatise on Steam Turbines, a distinctive service has been rendered by Captain Bremner. The author takes up the thermodynamics, the calculation and the construction of steam turbines in his first six hundred pages. He then turns to the application of steam turbines to marine propulsion and to railway traction. Metric rather than English units are employed but there is a table for converting either into the other.

PUBLICATIONS RECEIVED

A NOTABLE REPORT entitled An Enquiry into City of Sydney Refuse, by Rollo K. Newman, based on information collected in 1925 "at the instance of the city cleansing engineer" of the municipality named, was printed early this year. The report contains detailed physical and chemical analyses of the composition of Sydney refuse as delivered to destructors in that city, together with a classified summary of the nature of the refuse delivered during the whole year. This takes up a large part of the 117 pp. of the report. In addition, there are brief summaries of reports on various American cities gathered by correspondence and some data on refuse disposal in England. The conclusion of the survey is that "the best method" of disposal for Sydney "is the separation-incineration method."

FOR A NICKEL EACH any one of the following reprints from Public Health Reports, U. S. Public Health Service, may be obtained from Superintendent of Documents, Washington, D. C.: Notes on the Clarification of Colored Waters, by Lewis B. Miller, chemist, hygienic laboratory; Studies of Impounded Waters in Relation to Malaria: The Trend of Malaria in Horse Creek Valley, Aiken County, S. C., by E. H. Gage, associate sanitary engineer; Canyon Automobile Camp, Yellowstone National Park, by Isador W. Mendelsohn, associate sanitary engineer; Stream Pollution by Wastes from By-Product Coke Ovens, a Review with Special Reference to Methods of Disposal, by R. D. Leitch, associate chemical engineer. With the exception of the author of the last named paper, who is with the U. S. Bureau of Mines, all the authors named are with the U. S. Public Health Service.

New Books and Revised Editions

[*Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.*]

ENGINEERING METALLURGY: A TEXT-BOOK FOR USERS OF METALS—By Bradley Stoughton, Ph.B., B.S., Professor of Metallurgy, Lehigh University; author of "The Metallurgy of Iron and Steel"; and Allison Butts, A. B., B. S., Assistant Professor of Metallurgy, Lehigh University, Associate Editor of *The Mineral Industry*. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; pp. 441; 153 halftones and line cuts. $4.

"Written primarily as a text for students in the branches of engineering which are concerned more with the use than with the production of metals"; considered also as of value to some "workers in metallurgy" for preliminary study before going into more advanced books. Has introductory chapters on metals and other materials of construction, testing of metals and alloys, how metals occur in nature, etc., and final chapters on pyrometry and heat transfer and losses in industrial furnaces.

ENGINEERING PROBLEMS: A Brief Elementary Course for Engineering Students—By William G. Raymond, Late Dean of the College of Applied Science; Sherman M. Woodward, Professor of Mechanics and Hydraulics; and Irving H. Prageman, Assistant Professor of Mechanics and Hydraulics, all of University of Iowa. New York and London: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 47; 35 line cuts.

Designed "for use in review and orientation course pursued in recent years by sophomore engineering students in the University of Iowa." Reviews fundamental facts of elementary mathematics and physics, and is intended also "To illustrate and cultivate the application of the principles of these sciences, and elementary commonsense every day problems met in actual engineering;" and to "inculcate habits of systematic, neat, orderly, logical, consistent notes keeping and computation."

FREITRAGENDE HOLTZBAUTEN: Ein Lehrbuch für Schule und Praxis—Von C. Kersten vorm. Oberingenieur Studienrat an der Städt. Baugewerkschule, Berlin. Zweite, völlig umgearbeitete und stark erweiterte Auflage. Berlin: Julius Springer. Cloth; 8x11 in.; pp. 339; 742 line cuts and halftones. 36 reichmarks, in Germany.

DER HOLZBAU: Grundlagen der Berechnung und Ausbildung von Holzkonstruktionen des Hoch- und Ingenieurbaues—Von Dr.-Ing. Theodor Gesteschi, Beratender Ingenieur in Berlin. Berlin: Julius Springer. Cloth; 6x9 in.; pp. 421; 533 halftones and line cuts. 45 reichmarks, in Germany.

LETTERING EXERCISE MANUAL—By Jonathan Bright and John F. Faber. Inclined Gothic Lettering (Industrial Edition). Milwaukee, Wis.: Bruce Publishing Co. Paper; 5x8 in.; pp. 31. 28c.

A NEW MEASURING MICROMETER—By J. H. Dowell, F.O.S. [Reprinted from the Proceedings of the Optical Convention, 1926, Part II.] Aberdeen, Scotland: The University Press, Ltd. Paper; 7x10 in.; pp. 9; 10 line cuts.

PRACTICAL STRUCTURAL DESIGN IN TIMBER STEEL AND CONCRETE: A Text and Reference Work for Engineers, Architects, Builders, Draftsmen and Technical Schools; Especially Adapted to the Needs of Self-Tutored Men—By Ernest McCullough, C.E., Ph.D., Consulting Engineer; M. Am. Soc. C. E., M. Société des Ingénieurs Civils de France; M. Inst. Struc. Engrs. (British); Lt.-Colonel U. S. Army, A.E.F.; Author of "Practical Surveying," etc. Third Edition. New York: Scientific Book Corporation (Successors to U. P. C. Book Co. Cloth; 6x9 in.; pp. 416; 224 line cuts. $4.

Besides the correction of errors, the modification of some statements and the amplification of others to make them "more clear to self-tutored men" this edition contains "considerable new matter," including "a concise yet adequate treatment of reinforced concrete," the preface states. The first edition was reviewed in these columns Jan. 17, 1918, p. 128. To the second edition there was added a chapter in semi-rigid frames.

SOPHOMORE ENGLISH—By D. B. Cofer, Chairman of Sophomore English, The Agricultural and Mechanical College of Texas. College Station, Texas: The Agricultural and Mechanical College. Paper, 6x9 in.; pp. 48.

"The aim of this pamphlet is to assist the student in understanding the requirements of Sophomore English; to help him in acquiring proficiency in oral and written English; to guide him in selecting acceptable collateral reading; and finally to stimulate him in making his language a vital part of himself."

THE STORAGE OF LIQUID FUELS: With Particular Reference to Reservoirs of Steel and Reinforced Concrete and Precautions Against Fire—Report by Edward C. Sherman, M.Am. Soc.C.E., Supervising Engineer, Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., Delegate to the XIVth International Congress of Navigation, Cairo, 1926. Brussels: International Association of Navigation Congresses, 38 Rue de Louvain. Paper; 6x9 in.; pp. 18.

Letters to the Editor

A FORUM FOR DISCUSSION OF VIEWS OF ENGINEERS AND CONTRACTORS

Cost of Making Chlorine at the Sacramento Water Filtration Plant

Sir—In an article by Harry N. Jenks on chlorine manufacture at the Sacramento water filtration plant, in *Engineering News-Record*, July 29, p. 170, statements were made which did not seem to present the facts in their true light. If Mr. Jenks' figures were correct no city could afford to buy chlorine at 12½c. per lb. for water purification purposes but would have to produce its own chlorine. Believing that this is not the case an investigation of the Sacramento installation was undertaken with the following results.

To begin with, municipal bookkeeping often overlooks charges that must be considered as expense items in a business enterprise. For example, at the Sacramento plant, Marsh cells were scrapped as unsatisfactory and their cost was simply wiped out, this charge showing nowhere in production cost. In private enterprise such a loss would have to be carried until it could be balanced by profit. These Marsh cells were replaced with six diaphragm type cells, designed and built by an employee in the plant. The probable cost of these cells (no accurate data are available) was not less than $300 each—an investment for cells now in use of $1,800. These cells, being operated by their designer, work under the most favorable conditions possible. It is improbable that electrolytic cells in the average installation would be as well cared for as are the cells at Sacramento.

The annual production of chlorine at the Sacramento plant is about 15 tons, for which Mr. Jenks says the production cost varies from 5 to 7c. per lb. However, he does not give detailed costs on the processes involved and some very important items seem to be omitted from his figures. No mention is made of the cost of diaphragms which must be about $2 per ton of chlorine produced, or of anodes which would cost not less than $5 per ton of chlorine, or of labor, supervision and chemical control.

If the statement of the operating staff be taken as correct then the true picture of operating cost would be about as follows:

Direct cost per pound of chlorine produced:	Cents
2¼ kw.-hr. at 8¼ mills	2.125
4 lb. of salt at $7 per ton	1.4
Diaphragm renewals at $2 per ton of chlorine	.1
Anode renewals at $5 per ton of chlorine	.25
Total	3.875

Indirect expense:	
Maintenance cost on electrolytic installation at 33⅓ per cent per year	$600
10 per cent depreciation in electrical equipment	600
Interest on capital invested at 5 per cent	390
Insurance at 1 per cent	78
Total	$1,668

With an annual production of 15 tons of chlorine this amounts to $111.20 per ton, or 5.56c. per lb.

Adding direct and indirect costs the total cost becomes 9.436c. per lb. or, for 15 tons, an annual cost for chlorine production of $2,830. Contrasting this with $3,750, the cost of 15 tons of chlorine purchased at 12½c. per lb., it would appear that the city is saving $819.50 per year by producing its own chlorine. From this apparent saving, however, there should be deducted a proper charge for labor, supervision, chemical control, etc.

Moreover, it should not be forgotten that if chlorine were purchased by the city in 150-lb. cylinders at 12½c. per lb., the total capital invested in chlorine at one time probably would not exceed $200. If the city is willing to make a capital investment to secure chlorine at minimum cost, it would seem that the logical thing would be to invest in eighteen 1-ton chlorine containers which could be had for $200 each and which could be redeemed at any time for full purchase price. The annual charge against eighteen such containers, 5 per cent interest plus 1 per cent insurance, would be $216. With this equipment the city could buy chlorine in multi-unit tank cars for 6c. per lb. f.o.b. Sacramento, i.e., $1,800 for the annual 15-ton requirement. The cost of transferring 15 full containers from a multiple-unit tank car to the plant and replacing them with empties would be almost negligible; the three extra containers would serve the plant while a new supply was en route. On this basis of figuring, including interest and insurance charges, the chlorine cost would be $2,016 annually, or, when compared with their home-made chlorine costs of $2,830.50, a saving to the city of $814.50.

The foregoing analysis is predicated on the assumption that the figures given by the operating staff at Sacramento are correct. Those figures are somewhat inconsistent and therefore open to question.

If an electrolytic chlorine cell could operate at 100 per cent current efficiency, then 342 amp.-hr. would produce 1 lb. of chlorine. The cells installed at Sacramento are designed for 600 amp. and hence at 100 per cent current efficiency would produce 42.1 lb. of chlorine daily or, for 6 cells, 252.6 lb. Mr. Jenks states that the 6 cells produce 228 lb. of chlorine daily, consequently it must be assumed that the cells operate at a current efficiency of 90.3 per cent. Figuring back from this same efficiency, with a daily production of 228 lb. and the 2¼ kw.-hr. per lb. of chlorine produced, the overall efficiency of the motor generator set must be 63.2 per cent and this figure is used in the following calculations.

When the Sacramento plant was inspected, water was being filtered at the rate of 32 m.g.d. and was said to be dosed with chlorine at the rate of 0.5 p.p.m., or at the rate of 132.8 lb. of chlorine per day. At the same time the electrolytic cell installation was operating at 600 amp. and 25 volts. It was, therefore, if the operating department figures be taken as correct, producing 228 lb. of chlorine daily. This quantity of chlorine daily would dose 32 m.g. of water at the rate of 0.856 p.p.m. and not at the rate of 0.5 p.p.m. A dosage of 0.856 p.p.m. is an almost unbelievably high dosage, and certainly not one to be applied to raw water that is to be filtered and then again chlorinated after filtration, as is the practice at Sacramento.

If we assume that raw water is being dosed at the rate of 0.5 p.p.m. then the daily chlorine production was 132.8 lb. instead of 228 lb. and the current efficiency of the cells was only 52.6 per cent. If this assumption is correct then the power required to produce 1 lb. of chlorine was 4.29 kw.-hr. and not 2.5 kw.-hr., a difference which at 0.85c. amounts to 1.52c. per lb. of chlorine produced.

The fact that figures stated by the operating department do not check would seem to make it only reasonable to question whether the installation is actually as satisfactory as its operating staff claims and likewise would seem to make it obvious that the plant may be properly criticized for running under an accounting system which gives no true picture of operating costs.

C. T. HENDERSON,
Vice-President in Charge of Sales,
Great Western Electro-Chemical Co.

San Francisco, Calif.
Sept. 17, 1926.

Sir—It seems quite regrettable that Mr. Henderson should generalize so freely from the meager data given in the writer's article in *Engineering News-Record* of July 29, 1926, p. 179, from equally meager information gathered during his reported inspection of the Sacramento electrolytic chlorine plant.

Alluding briefly to the preliminary criticisms in Mr. Henderson's letter, the writer can but state that accurate and detailed data *are* available on every phase of the construction and operation of the plant in question, and these will be published in due course. As to the inclusion of the cost of the original cells that were discarded, the writer does not agree with Mr. Henderson that these constitute a proper charge against the plant as it now stands, and certainly they have no bearing on the economics of electrolytic chlorine plant investment as such.

As to the reprehensible method of bookkeeping that has been discovered, the writer hastens to accept the responsibility for himself alone, since the much-maligned system of municipal accounting has not entered at all into the writer's conclusions as to the profitableness of the use of home-made chlorine.

The writer wishes to remove Mr. Henderson's perplexity regarding the chlorine cell efficiencies, which he shows to be ridiculously low, because his conclusions are based on an erroneous understanding of the operation of the plant in relation to chlorine dosing. Mr. Henderson is doubtless on familiar ground in analyzing chlorine plant performance

itself, but if a total dose of 0.856 p.p.m., when double chlorination is practiced, appears "almost unbelievable" to him, he has yet much to learn on the subject of chlorination. Unfortunately for his conclusion that the current efficiency of the cells at the time in question was only 52.6 per cent, the Sacramento water supply was actually being given an aggregate raw water and filtered water dose of 0.856 p.p.m. Consequently the argument set forth loses its intended effect.

Finally, in reference to the investigation Mr. Henderson mentions, no one at the Sacramento plant is aware that any representative of Mr. Henderson's company made the reported inspection of the chlorine plant. The writer recalls, however, a recent visit from a certain gentleman of mystery who gave out nothing but his name, and claimed he was studying the efficiencies of various processes for certain "interests." Under the circumstances, the writer had neither the time nor inclination to inform him completely on the subject. The replies to his queries were as fragmentary as his questions were unrelated to each other, and as the gentleman took no notes in writing, what he remembered was evidently not enough to enable an intelligent discussion of local conditions to be made by the "interests" he represented.

In justice to Mr. Henderson's honest doubts, however, the writer wishes to state that perhaps he may find all the information sought by him, in a professional paper which the writer has prepared on the subject, for presentation at the forthcoming annual convention of the California Section, American Water Works Association.

Ames, Iowa,
Oct. 9, 1926.

HARRY N. JENKS,
Associate Professor of Sanitary Engineering, Iowa State College;
Formerly Superintendent of Pumping and Filtration Works, Sacramento, Calif.

Columbia Basin Studies in Progress

Sir—The state of Washington, under direction of the writer and in co-operation with the U. S. Bureau of Reclamation, is carrying on additional studies of the Columbia Basin irrigation project. These cover two distinct lines. The first, a power study, is being made by District Engineer G. L. Parker of the U. S. Geological Survey, and Eugene Logan, consulting hydraulic engineer, Spokane, Wash., to determine power possibilities on Clark's Fork and Columbia River within Montana, Idaho and Washington, and the effect upon future power development of alternative schemes of irrigation development.

There are two major alternatives for irrigation: (1) a gravity diversion from Clark's Fork of the Columbia at Albany Falls just within the Idaho boundary, and (2) by pumping from the Columbia River, using power to be developed by a dam in the vicinity of the head of the Grand Coulee. Several engineering boards have reported on the project, all favoring the gravity development.

The gravity project has been worked out for several different areas, ranging from about 1,000,000 to 1,083,000 acres. If the area under the Clark's Fork gravity diversion is reduced to the former figure the maximum project may still be developed using water from other sources. The smaller diversion from Clark's Fork would permit a very material increase in power development on the lower river at "Z" Canyon and other locations.

While the Pacific Northwest has, at the present time, very large quantities of undeveloped water power, its commercial and industrial development is going forward at a very rapid rate, and it is believed that the development of cheap power in connection with the Columbia Basin irrigation project may eventually have a large bearing in the development of a sound and economic plan for its construction.

The second study referred to is a study of agricultural markets with a view to determining what is the prospect for an outlet within economic distance for the products of the Columbia Basin project when built. This study is being carried on by E. F. Dummeier, professor of agricultural economics in Washington State College, assisted by a committee composed of Prof. George Severance, head of the Department of Farm Management, Prof. O. L. Waller, head of the Department in Civil Engineering, both of Washington State College, and the writer.

This investigation will include studies of the growth of agricultural production in Washington and in competitive territories during the present century, studies of the commercial and industrial growth of local and Pacific Coast markets during the same period, and studies of special crops to which the Columbia Basin project is particularly adapted and which will stand long haul and high freight rates. It is believed that these market studies will prove helpful not only to the Columbia Basin project but to the whole question of reclamation development within the state, and that they may even throw some light upon the problem of national reclamation.

R. K. TIFFANY,
State Supervisor of Hydraulics.

Olympia, Wash.,
Nov. 6, 1926.

Higher Salaries for Federal Judges

Sir—The time has arrived for final action on behalf of the Federal Judges Salaries bill. The bill has passed the Senate, and is definitely set for a vote in the House of Representatives Dec. 9. It is believed the bill can be passed if sufficiently vigorous support is given to it, and every man and corporation does his or its part. It must be passed if the quality of the Federal Judiciary is to be maintained.

American Engineering Council and its constituent engineering societies have been vigorously supporting the bill in the Senate and House of Representatives, and have been represented at some congressional committee meetings.

The passage of this bill deeply concerns not only every American Engineer, but the welfare of our country. It is grossly unjust to have invited capable lawyers to give up profitable practices and take an appointment as a United States circuit or district judge in days past, when the salary afforded a comfortable and dignified living, and then, when the cost of living goes up, not to increase the salaries at least proportionately. This condition is not only unjust but it is poor business because the judges cannot do their best work when their minds are harrassed with the almost impossible problem of making both ends meet, and at the same time living with the dignity which their position requires. American Engineering Council is certain that the members of the constituent engineering societies, having undertaken to see this legislation safely through, will give hearty response to this call for appeal to the members of Congress.

United States district judges are now receiving only $7,500, and the circuit judges, $8,500, per annum. The chief justice of the Supreme Court of the United States receives only $15,500 and the associate justices only $15,000 per annum. The salaries of the United States circuit and district judges are much below those paid in many states, and are only one-third of the amount paid to the corresponding judges in the state of New York. These United States judges can live on their present salaries only by the greatest economy, and it is actually impossible for them to send their children to college on these salaries. They are practically shut off, by their position, from all other ways of earning money, except from simple investments, savings for which it is impossible to accumulate. A considerable number of the judges have resigned in recent years and months because of this situation. All of those in the larger cities feel unjustly treated, and some of them feel bitter. Not a few of the judges will resign if the bill does not pass on Dec. 9. The bill to be voted upon increases the salaries to $10,000 for the district judges, $12,000 for the circuit judges, $20,500 for the chief justice of the United States, $20,000 for the associate justices, and corresponding increases for other federal judges.

Every engineer should write to his representative in Congress in the early days of December urging him to be present Dec. 9, when the Graham Bill, H. R. 10,544, will be voted upon, and to give the bill his hearty support. If the bill should not pass Dec. 9, the leaders of Congress predict that it will be many years before another attempt will have any chance for success.

American Engineering Council, and its constituent societies, was one of the three great factors in passing the Patent Office Relief Bills. This Judges Salaries Bill is of equal importance with the Patent Office Bill. We believe it can be passed, but only if every man will do his part. We hope and expect that the great majority of the engineers will respond to this call for public service.

DEXTER S. KIMBALL, President,
EDWIN J. PRINDLE, Chairman,
Patents Committee, American Engineering Council.

Washington, D. C.,
Nov. 8, 1926.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

State Railroad and Utility Commissioners Meet

Discuss Water Power and Interstate Relations—Interest in Bus Regulation

(Engineering News-Record Staff Report)

At their meeting at Asheville, N. C., from Nov. 9 to 12, members of the National Association of Railroad and Utilities Commissioners, representatives of the regulating bodies of all the states of the Union, exchanged views on the many subjects which now come before the various state commissions and the Interstate Commerce Commission for consideration. About 175 members and guests were in attendance.

Unlike the majority of technical societies this association has no divisions which are interested in special subjects, for although the commissions have their specialists the commissioners, themselves, have to deal with all the subjects that may come before the commissions for consideration. As a result the average attendance of the session is high and interest in the subjects under discussion is sustained.

Of special interest to the civil engineers was the round-table discussion on water power held during the evening of the first day at which John H. Small, chairman of the Rivers and Harbors Congress, spoke and at which the special committee on water power made its report. Other subjects included the report of the committee on safety of railroad operation, a paper by Carl D. Jackson on progress in formulating a uniform regulatory law, a paper on motor-vehicle regulation as viewed by the regulators, by C. C. McChord, formerly a member of the Interstate Commerce Commission and now representing the national automobile interests, a report of the committees on motor vehicle transportation and on motor vehicle legislation, and reports of the committees on valuation and on grade crossings and trespassing.

Water Power

The report of the committee on water power drew attention to the diverse methods of regulating water power in the various states and the lack of such control in some states, and emphasized the necessity for placing the administration of these laws in the hands of the public service commissions. The committee favors the inclusion of provisions for the recapture of water power rights in state laws relating to development of water power. Only three states, New York, Pennsylvania and Wisconsin, have such provisions. The need of adequate standards as a basis for approval or rejection of applications for power rights in most states was also noted by the committee.

The committee on railroad valuations reported the progress in the submitting of tentative and final values on railroad properties and outlined some of the important developments which have occurred during the year.

Much interest was shown in the matter of legislation for the regulation of motor bus and motor truck operation. Last year the convention indorsed a tentative bill for such regulation which was introduced into Congress but was not passed. Since that time the Interstate Commerce Commission has been holding hearings on the same subject and the association has offered to co-operate with the commission in the study of the subject. Representatives of the truck operators appeared before the convention to oppose the passing of any legislation affecting trucks at this time.

New Officers

The following officers were elected for the ensuing year: President, John F. Shaughnessy, chairman of the Nevada commission; vice-presidents, Henry G. Wells of the Massachusetts commission and Lewis E. Gettle, chairman of the Wisconsin commission. The secretary, James B. Walker of New York and assistant secretary Clyde S. Bailey of Washington were re-elected. The meeting next year is to be held at Dallas, Texas.

Engineering Fifty Years Ago

From *Engineering News*, November, 1876

A CAR propelled by compressed air has been used successfully for more than two months on a street railway near Paisley, in England, under every condition of traffic and weather, performing a trip of three miles for each charge of air, at a cost of about one cent a mile. When the rails are not slippery with mud or ice, a considerable surplusage of air is left in the tanks.

Louisville Defeats Bridge Issue

The voters of Louisville at the election on Nov. 2 decisively defeated a proposed bond issue of $5,000,000 for the construction of a free bridge over the Ohio River.

San Francisco Voters Pave Way to Buy Water-Works

By a vote of 51,592 for and 40,706 against, San Francisco carried through an amendment at the recent election whereby water bonds have been taken out of the bonding limit. This, writes M. M. O'Shaughnessy, city engineer, will enable the city to acquire title to the Spring Valley water system for $38,000,000, and to spend $24,000,000 in completion of the Hetch Hetchy project.

Asphalt Paving Conference Held in Washington

Practices in Design and Construction Reviewed—Research and Theory Given Much Attention

(Engineering News-Record Staff Report)

Meeting at the same time and place as the convention of the American Society for Municipal Improvements, the fifth annual paving conference of the Asphalt Association was well attended. The combined registration was approximately 700. The sessions covered the mornings and afternoons of the week of Nov. 8-12, and were held in the Mayflower Hotel, Washington, D. C. Social and recreational features included a dinner dance, a trip to the Pimlico race track near Baltimore provided by the Standard Oil Co. of New Jersey, and a golf tournament at the Congressional Country Club.

Especially worthy of note was the session under the auspices of the Association of Asphalt Technologists on theory and research held in the auditorium of the National Research Council Building. Interest was displayed in the discussion not only by the engineers but by paving contractors whose practical views on the questions raised contributed much to the value of the meeting. A resolution was adopted commending the Asphalt Association on its move to inaugurate temporary asphalt paving schools during the coming winter.

The program may be divided for convenience into four divisions—(1) Contractors' problems, (2) research and tests, (3) construction and design practices, (4) salvage.

Contractors' Problems

Standard contract forms, financial and ability statements, licensing of contractors, day labor and viewpoints on engineering inspection were discussed by the contractors' forum. General R. C. Marshall, manager, Associated General Contractors, held up the irresponsible contractor as the greatest problem facing the industry today; he also explained the standard set of questionnaire forms which the A. G. C. has recently designed to place contracting on a sound economic basis. Views differed as to the competency of present inspection methods. It was suggested that group conferences between inspectors, engineers and contractors held periodically in which all could state their views and requirements, would be helpful.

In his paper on "Researches on Bituminous Paving Mixtures," W. J. Emmons, highway research specialist, U. S. Bureau of Public Roads, described two pieces of apparatus that recently have been developed. The first is designed to reproduce the effect of traffic on a pavement and consists essentially of a wheel on the circum-

(Continued on p. 847)

A.S.M.I. Convention Has Lengthy Program

More than a Score of Papers and 42 Committee Reports Keep Members Busy

(Engineering News-Record Staff Report)

A registration perhaps above the average and an attendance ranging from 30 to 200 at the various sessions, an endurance test in the form of nearly 27 papers and over 42 committee reports, a joint session with the Asphalt Conference, a "supper-dance divertisement," an afternoon excursion to the Pimlico race course, and a final day for golf, sums up the 32nd annual convention of the American Society for Municipal Improvements, held at Washington, D. C., Nov. 8 to 12. The endurance tests of so many papers and reports was too much for most of the members, the attendance at all but the first day's session being small, so that many of the speakers addressed empty chairs.

Thirty committee reports were scheduled for a single session but most of them were of the "progress" type so common to technical societies. A few reports, before the society for criticism from a year or two upwards, were "approved" (some with only 30 or 40 present) and sent to letter ballot. The nominating committee's report, of the one-step-up-the-ladder variety, except for the treasurer, who was continued in office, was submitted and, with 27 members present, the secretary was instructed to "cast one ballot," etc. The principal officers for 1926-27 are: President, C. Arthur Poole, city engineer, Rochester, N. Y.; first vice-president, J. B. Hittel, chief street engineer, Board of Local Improvements, Chicago; second vice-president, John Klorer, city commissioner (formerly city engineer), New Orleans; third vice-president, George F. Fisk, engineer in charge pavement construction, Buffalo; treasurer, P. L. Brockway, city engineer, Wichita, Kan.

Secretary Reappointed

The executive committee announced the reappointment as secretary of C. W. S. Sammelman, 315 Commercial Building, St. Louis, Mo.; also two new committees, one on revision of constitution and one on the publication of a quarterly bulletin, with advertisements. Over a hundred new members were elected. It was announced that the membership has been about stationary for two years but that the financial condition of the society has materially improved.

Those present directed the executive committee to drop the committee on wood block paving, on the ground that it had done little and that in view of the present status of that material the committee is no longer needed.

In place of a formal presidential address at the opening session, T. Chalkley Hatton, chief engineer Milwaukee Sewerage Commission, presented an outline of the government of Washington, D. C., both past and present, supplied by the secretary of the Commissioners of the District Columbia. This was followed by commendation of the technical press in general, by special mention of the articles on "Engineering Work in Small Cities," published in *Engineering News-Record* last year, and by some emphatic remarks on the lack of interest in the committee work of the society.

A summary of the technical proceedings of the convention begins on p. 830 of this issue and a notice of the exhibits on p. 851 of our Manufacturer's Section.

Construction Council Calls Mortgage Bond Conference

Franklin D. Roosevelt, president of the American Construction Council, has announced that invitations are being issued by the Council to all interested parties for a national conference to discuss the subject of state supervision of real estate mortgage houses and the development of uniformity in appraisal procedure for construction projects. This action follows the suggestion of S. W. Straus made before the Council's fifth annual convention in Cleveland last Tuesday following which the general convention voted that the officers of the Council consider calling such a conference.

The conference is being called for Tuesday Nov. 30 at Mr. Roosevelt's law offices at 120 Broadway, New York City. The invitations, which are being extended by telegraph so as to enable the Council to secure as early an expression of opinion as possible from the interested groups, include leading real estate mortgage bond houses, realty people, investment bankers, surety companies, insurance companies, building owners and managers and others closely allied with this general problem. Invitations are also being issued to representatives of the state governments throughout the country so as to facilitate the co-operation of the industry with state authorities.

Seattle Voters Defeat Proposed Council-Manager Plan

The proposed new city charter for Seattle, Wash., outlined and commented on in *Engineering News-Record*, April 22 and 29, 1926, pp. 667 and 676, was defeated by a 2 to 1 vote on Nov. 2, only 43 per cent of the registered voters marking their ballots on this proposal. It is reported that the new charter was opposed by the mayor, Mrs. Bertha K. Landes, and by the members of the city council. Mrs. Landes, who a few months ago advocated a proposed charter amendment providing for a manager, protested that the charter just defeated provided for a return to the ward system.

San Francisco Bay Bridge Project

In the table of the San Francisco proposed bridges, Oct. 28, 1926, p. 720, the location of the bridge proposed by Edward A. Bertram should be "from 12th and Howard St. and from 3rd and Townsend St. railroad station, San Francisco, to Oakland at West 14th St. and the 16th St. railroad station by way of the Southern Pacific Co. mole."

Engineering Council Meets at Ithaca

Plan for Federal Department of Public Works Offered—Other Problems are Discussed.

Presentation of a plan for the organization of a federal Department of Public Works, a vote to co-operate with the National Association of Manufacturers and other bodies in devising a plan to minimize the volume of corporate reports, which it is charged, impose on industry burdens costing millions of dollars annually, and the backing of Secretary Hoover's plan for a national policy in developing water resources, were features of the two-day sessions of American Engineering Council held Nov. 11 and 12 at Ithaca, N. Y.

The plan for the organization of federal public works is embodied in a progress report adopted by the Administrative Board of the Council. The committee suggested that the following units of the federal administrative organization be included:

Interior Department — Geological Survey, Bureau of Reclamation, Alaska R.R. National Park Service, General Land Office. The Office of Indian Affairs and the Administration of Alaska and Hawaii are both listed under the designation of "serve or include."

Agriculture—Bureau of Public Roads, except the Rural Engineering Division; and the Forest Service, except the silvicultural functions. The Weather Bureau is not included.

War—The non-military river and harbor work of office of Chief of Engineers, Board of Engineers for Rivers and Harbors, Mississippi River Commission, California Debris Commission, Supervisor of the Harbor of New York, Northern and Northwestern Lakes Survey, Board of Road Commissioners for Alaska, Alaska telegraph and cable system.

Treasury—Supervising Architect.

Commerce—The primary control work only of the Coast and Geodetic Survey, about fifteen per cent of the Survey.

Independent—Federal Power Commission, Office of Public Buildings and Public Parks of the National Capital.

General—Departmental services for maintenance and operation of buildings.

Congress—Architect of the Capitol.

E. O.Griffenhagen of Chicago, representing the Society of Industrial Engineers, is chairman of the American Engineering Council's committee which prepared the report.

Co-operation with the manufacturers has in mind the checking of the flood of demands for data from corporations made by federal and state governments. The engineers were urged to act by the manufacturers' association. The Council, under the direction of its president, Dean Dexter S. Kimball of Cornell, will begin at once laying plans for "a comprehensive attack on the problem," with the aid of federal and state officials, industrialists, accountants and other interested groups.

The Council voted to hold its annual meeting in Washington, D. C., Jan. 12 to 15.

Bids on $20,000,000 Bridge Bonds Asked by Port Authority

Private bids of financial houses on a first installment of bonds for building the Fort Lee bridge over the Hudson River have been asked by the Port of New York Authority, to be opened Dec. 9. The estimated final cost of the bridge is $60,000,000 but the initial cost (with reduced traffic capacity) will be ten millions less. The first issue of bonds is to cover the first half of the total cost. A contribution of $10,000,000 is likely to be made by the states of New York and New Jersey through direct appropriation.

It is specified in the call for bids that the interest rate shall not exceed 6 per cent and that the issue shall be redeemable at a price not to exceed 105; maturities are to range from 10 to 24 years and the whole issue is to be callable after 10 years.

The bridge to be built under the proposed issue was authorized by the legislatures of the two states at their latest sessions. It is to cross the Hudson from Fort Washington Point (about West 178th St.) Manhattan Borough, to a point directly opposite in New Jersey. A main span of 3,568 ft. is required. The structure will be of suspension type and is so designed as to be capable of initial construction for four lanes of vehicles and later enlargement under traffic to eight lanes and the addition of a partial lower deck for street-car or bus service.

Announcement has also been made of a public hearing before the U. S. District Engineer on the Port Authority's application for approval of plans. The hearing is to be held at 10 a.m. Dec. 9 at 75 West St., New York.

Asphalt Paving Conference

(*Continued from p. 845*)

ference of which are a number of rollers. This wheel, operated by an electric motor, revolves on the paving sample and the rollers as they come into contact with it produce the effect of impact. The second machine mechanically determines means of vibration by the voids in a sample mixture. F. C. Field, chemist, Asphalt Association, showed lantern slides of the Hubbard and Field testing machine for determining stability values. The sample is forced through an orifice by means of a vertical testing head, the test requiring about the same time as the usual penetration test.

A gasoline deterioration test was explained by Henry L. Howe, Jr., director, Municipal Testing Laboratory, Rochester, N. Y., which provided for measuring the loss in weight of a sample subjected to the drip of 10 c.c. of gasoline.

Stability, "the resistance of a paving mixture to interval movement" was the main factor considered in the research papers. Gene Abson, director, Chicago Paving Laboratory, Inc., in connection with his paper on the voidage theory of design, presented curves showing that shear, which is the principal distorting force caused by traffic, has a direct relationship to per cent of filler used, i.e., to voidage. The most desirable mixtures contained 25 to 35 per cent filler. The limiting factor in adding filler and increasing shear strength is the workability of the mixture on the street. It was claimed that with the aid of stability values such as provided by a shear test, some basis for design is offered.

What was characterized as a progress report on the stability of pavements that had been under traffic for some time was given by Prévost Hubbard, chemical engineer, the Asphalt Association, and illustrated by lantern slides of New York streets. In his paper, "Influence of Shape of Sand Grains on the Stability of Asphalt Paving Mixtures," Victor Nicholson, engineering chemist, department of public works, Chicago, stated that a well-graded sand is not always the most stable. When it is necessary to use a very poor sand, 200-mesh stone dust materially increases the stability of the mixture. Many well-graded sands have been subjected to water action and their consequent roundness is detrimental to stability.

Construction and Design Practices

It was in respect to construction and design practices that the most papers were presented. R. M. Smith, chief engineer, provincial highway department of Ontario, Canada, read a paper on the asphalt macadam mixing methods which he is using. Ontario encourages tourist traffic and for this reason detours and construction of roadways in half-widths have been discouraged; mixed macadam has been substituted since it can carry traffic while being constructed. Vehicles totaling 2,000 per day were said not to be appreciably hindered by the construction operations, nor did the contractor complain of undue interference. A central quarry providing 300 cu.yd. per day is used. The asphalt and rock are both heated to 300 deg. mixed and trucked to the road. Mechanical spreaders are used. By using all the material from the crusher each day no stockpiles are allowed to accumulate with consequent segregation. The chips used in the mix are shipped in.

Black base was not given the consideration that it has been in past conferences, possibly due to a lack of time for discussion. Hugh W. Skidmore, president, Chicago Paving Laboratory, read a paper on "Black Base and Its Place in Standard Specifications," which consisted of a recounting of practices in various parts of the country. "Construction of Granite Block Pavements with Asphalt Filler," by C. M. Pinckney, chief engineer, Bureau of Manhattan, New York City, was read by Felix Kleeburg, chief chemist, Borough of Manhattan. A filler of penetration 60 to 70 and melting point of 115 to 130 consisting of 60 per cent asphaltic paving cement and 4 per cent sand is used. The filler is applied by flushing over the pavement and brooming into the joints at a temperature of 325 to 400 deg. Flushing the joints probably uses more material, but saves labor. Also the old method of pouring the filler into the cracks wasted a great deal, especially on windy days.

Voters Approve $20,000 Salary for Stockton City Manager

At a recent election in Stockton, Calif., there was on the ballot a measure put there by initiative petition signed by ten per cent of the qualified voters, proposing a reduction in the city manager's salary from $20,000 to $10,000 per year. The outcome of the election was 3,377 votes for reducing the salary and 5,807 votes for continuing the $20,000 rate. The election was purely on municipal matters, including fourteen proposed amendments to the city charter, and the initiative measure referred to above.

W. E. Rosegarten, traffic engineer, Asphalt Association, read a paper on "Asphalt Maintenance without Recourse to Large Plants," which consisted of a resumé of the small asphalt mixing and heating plants that are now available. An important point brought out in connection with the patching practices was that too many bumps are left for the traffic to level down. All patch gangs should be accompanied by a small roller so that very little, if any, compression will be left for traffic. More and better raking, longer rolling and the eliminating of personal factors by the use of mechanical devices were advocated.

Salvaging

Two papers were read giving specific information on salvaging work. The first of these by H. B. Smith, county engineer, Burlington County, N. J., "City Type Pavement on Rural Highways," described sheet asphalt top on old macadam roads. In preparing the base the old macadam road had to be widened from 12 to 18 ft. A trench 6 in. deep and 4 to 5 ft. wide on either side of the old stone road was dug and filled with 2½-in. broken stone. After the addition of a gravel binder, it was thoroughly rolled until compact. (Discussion brought out that better drainage might result if the gravel was omitted.) The center portion of the road was scarified and the excess material in the crown evenly distributed. The road was then covered with screening, water bound and rolled, and after being subjected to traffic for approximately 30 days the asphalt surface composed of 1½ in. of binder and 1½ in. of surface mixture, was added. The 3-in. sheet asphalt pavement cost on an average $1.40 per yard. Col. R. Keith Compton, director of Public Works, Richmond, Va., in his paper "Economics of Salvaging Old Pavements," stated that because of the lack of well balanced and continual cost accounting methods and the intangible value of time saved over constructing an entirely new paving, the actual money saving from resurfacing is hard to determine. Nevertheless, he gave a number of instances where considerable saving had occurred over the estimate made for a new pavement. It was Mr. Compton's opinion that should it be necessary to make a great number of openings in an old pavement, that it is much cheaper to salvage the old material for use on other streets and to construct an entirely new base.

WASHINGTON NOTES

THAT the Board of Army Engineers, of which General Herbert Deakyne is chairman, is thoroughly convinced the Lakes-to-Hudson waterway should not be built is revealed by notices which have been sent to those which may wish to contest the board's decision. At the request of the Committee on Rivers and Harbors of the House of Representatives the Board has reviewed the report which it submitted to Congress at its last session. While the report will not be given out until it is submitted to the committee, early in December, the notice demonstrates that the Board has not changed its opinion that the project is not feasible. In fact, the character of the notice, which states that the "construction and operation of the proposed waterway would require an expenditure largely in excess of the probable benefits to be derived therefrom," causes many to think that the review of the figures has led to even more positive conclusions that the construction of this waterway cannot be justified. Judging from the information which was furnished the board as to the possibilities of providing additional railroad facilities into New York City, it is thought likely that the report will present conclusive evidence that the railroads are in a position to expand their present facilities greatly.

A HEARING before Major H. M. Trippe at Radford, Va., Oct. 28, in connection with the proposed hydroelectric development on New River by the Appalachian Power Co., brought out protests from several interests who fear that they will be damaged by this project. Representatives of the Virginian Ry. contended that the proposed dam would interfere with the water supply for their Narrows steam plant. Witnesses for the Norfolk and Western Co. fear that an ice hazard will be created for their bridge over New river. The Electro Metallurgical Co. requested that any license issued to the Appalachian company safeguard the water supply for its power plant at Kanawha Falls. The Appalachian company is going ahead with its borings and other investigations.

The West Virginia Power Co. has applied to the Federal Power Commission for a license covering its project on New river just below Bluestone river. The company has completed the investigations under its preliminary permit issued in 1923. The company proposes to install 125,000 hp.

BECAUSE of the organized opposition of the scenic beauty associations the Cumberland Hydroelectric Power Company is understood to be on the point of withdrawing its application for rights on the Cumberland River in Kentucky. Those who prefer to see this power utilized for the upbuilding of the surrounding region point out that the scenic associations by no means have established a case, as peculiar conditions existing at Cumberland Falls make it possible to arrange so that all the water necessary to preserve the beauty of the falls is available.

Local feeling is said to be aroused by these outside activities that promise to rob the region of more than 100,000 hp. all to no purpose. The power company has expended great effort to work out a plan of development which will improve rather than detract from the beauty of the falls, but it is understood to be ready to abandon the project rather than insist upon a course which seems to be antagonizing the public in other states, if not in its own.

Consulting Engineers Discuss Expert Evidence

At a dinner meeting in New York, Oct. 15, the American Institute of Consulting Engineers listened to a discussion of the subject of expert evidence by three leading members of the New York bar—Ex-Attorney General George W. Wickersham, Judge Charles M. Hough, of the United States Circuit Court, and Mr. Franklin Nevius. Mr. Wickersham traced the development of the expert witness from the early days of English jurisprudence to modern times with special reference to the several state statutes which provide for expert witnesses to be appointed by the court. Judge Hough, whose long experience, particularly with patent causes, entitles his opinion to much respect, referred briefly to the historical development of the expert, but more particularly directed his remarks to the complications of the expert under the current system. Mr. Nevius, while defending the current system when the expert is of high character, suggested an improvement whereby in case of difference of opinion between opposing experts, the court may appoint of its own motion one or more experts responsible only to the court, the testimony of all three groups to go to the jury without prejudice.

By far the most important thought brought out by all three speakers was that the expert himself has in his own hands his influence on the jury and that in the long run that expert witness who confines his statements to expositions of facts known to skilled and experienced men in a particular field would better influence the jury than that one who elaborates those facts by too intense advocacy. H. de B. Parsons, consulting engineer, New York, president of the Institute, presided.

Council-Manager Plan Adopted at Oklahoma City

By a large majority the voters of Oklahoma City, Okla., on Nov. 2, adopted a council-manager charter. Eight councilmen will be elected, by wards, and a ninth member, as mayor, at large, all on non-partisan ballots. The council will appoint a city manager, as chief administrative officer, and the mayor will be called chief executive officer. The manager will prepare the budget. The salary of the mayor will be $1,000 a year and of the other councilmen, $10 a meeting, but not over $50 a month.

RANDOM LINES

Some Information On Dams

"The Colorado River has been, and is, rather gay, but there is no other river in the United States that will pay as big a per cent for money invested in the harnessing.

"In making the dams, they should all be started at one time, otherwise Dam 2 will only get 75 to 80 per cent of the water that Dam 1 gets; Dam 3 will in turn get less water than 2, and there will be less and less water the farther down the stream they go.

"In making spillways the mistake that was made in the Assuan Dam in Egypt must be avoided. There the spillway is underneath the dam, and in seventy-five years it will cut the dam so it will cave in. The spillway should be kept as far from the dam as possible. The dam should be curved like a rainbow up stream, the most important thing being to fill in well above the dam so that the pressure of the water will be toward the bottom, not toward the dam. * * *

The 6,000,000 tons of silt yearly can be removed by the river itself. The river will pay for the work as there must be all kinds of gold in the bottom of the stream. By letting the river do the work the sand stirred up will be sent out into the Gulf of California before it has time to settle again, and dikes will not be needed here to protect the Salton Valley."—One Fred Larsen in November *Current History*.

* * *

Rival Organizations

Our old friends the American Society of Baking Engineers have been noted before here, but up to now we did not know that "it corresponds in its required qualifications to the American Society of Civil Engineers." But that is what the *Arizona Gazette* says.

* * *

Starting the Third Hundred

(206) *Cinematograph Engineer* — Mr. Willard J. Gramm, of Lima, Ohio, who also doubles in brass as an "automotive engineer."

(207) *Baseball Park Engineer*—Listed in Hendricks' Directory.

(208) *Public Relations Engineer*—Mr. Arthur Huntington, of the Iowa Ry. & Light Corp.

(209) *Taxation Engineers* — They are needed, says an editorial in the New York *Times*.

(210) *Dental Engineer*—The U. S. Veterans' Bureau in an official bulletin tells how he put a new chewing apparatus on an injured doughboy.

(211) *Clam-Shell Engineer* — "It was not long before he got a job with the Missouri Pacific Railroad Company, being employed for what is called a "clam-shell engineer." Translated that means he had charge of a stationary engine that loads or unloads a kind of grit resembling clam shells used in railroad construction. — Kansas City *Star*.

World Motor Transport Congress to Be Held in New York

The third World's Motor Transport Congress sponsored by the National Automobile Chamber of Commerce will be held in New York City, Jan. 10 and 11. Though the principal part of the congress will be devoted to problems affecting the industry primarily, there will be phases of the congress treating upon the development of motor transport, the general subject of good roads, and traffic.

St. Paul-Minneapolis Sewage Problem Discussed

Representatives of the city government of St. Paul and Minneapolis and officers of the Metropolitan Planning Association were entertained recently at the Field House of Columbia Park, Minneapolis, by the Board of Park Commissioners of Minneapolis. The purpose of the meeting was to discuss the Metropolitan Sewage Problem, a report on which had been made by the Metropolitan Planning Association. The speaker of the evening was H. R. Crohurst of the U. S. Public Health Service in charge of the investigation on pollution of the Mississippi River between Camden, Minneapolis and Red Wing, Minnesota now being carried on. After Mr. Crohurst's talk there was a general discussion of the problem which resulted in recommending to the council of each city that a special sub-committee composed of the city engineers of South St. Paul, St. Paul and Minneopolis, the city attorneys of the same cities and the city planning engineers of St. Paul and Minneapolis be appointed to go into the problem thoroughly and represent the three cities and their environs before the state legislature when the report of the Interim Committee appointed by the governors of Wisconsin and Minnesota is made to the legislature.

Civil Service Examinations

NEW YORK STATE DEPARTMENT OF HEALTH

For examination for the position noted below apply to the Civil Service Commission, Albany, N. Y., by or before Dec. 4, 1926.

Assistant Sanitarian (Assistant Sanitary Engineer) in the New York State Department of Health—One immediate appointment to be made at $2,500, salary range $2,500 to $3,000. The duties of the position require a knowledge of design, construction, operation and supervision of water supply systems, water purification works, sewerage and sewage disposal systems, the principles of chemistry and bacteriology as applied to sanitary quality of public water supplies, and the principles governing stream pollution and its prevention. Candidates must be graduates of a course of civil, sanitary or public health engineering for which a degree is granted, and must in addition have had at least one year of experience in sanitary engineering. Higher education may be given some credit.

Engineering Societies

Calendar

Annual Meetings

HIGHWAY RESEARCH BOARD, OF NATIONAL RESEARCH COUNCIL, Washington, D. C.; Annual Meeting, Washington, D. C., Dec. 2 and 3, 1926.

AMERICAN ROAD BUILDERS ASSOCIATION, New York City; Annual Convention and Road Show, Chicago, Ill., Jan. 10-14, 1927.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York City, Jan. 19-21, 1927.

ASSOCIATED GENERAL CONTRACTORS, Washington, D. C.; Annual Convention, Asheville, N. C., Jan. 24-28, 1927.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Quebec, Feb. 15-17, 1926.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting, Chicago, Ill., Feb. 22-24, 1927.

The California Section of the American Water Works Association at its annual convention in San Diego Oct. 27-30 elected the following officers: President, S. B. Morris, Pasadena; vice-president, Joseph Ryland, San Jose; secretary-treasurer, Paul E. Magerstadt, Oakland. San Jose was chosen for the 1927 meeting.

Personal Notes

T. C. MACNABB, who since 1917 has been superintendent for the Canadian Pacific Railway Co. at Revelstoke, B. C., has been appointed engineer of construction of the company's western lines, with office at Winnipeg, Man. Mr. MacNabb is a graduate of the University of Manitoba and has served the Canadian Pacific since 1902; since 1908 he has been successively assistant engineer on construction, division engineer on maintenance, assistant engineer for Saskatchewan and superintendent at Revelstoke.

L. F. MERRYLEES, Vancouver, B. C., who was a construction engineer for the Northern Construction Co. and J. W. Stewart on the Ballantyne pier and other work, and on the valuation of the Grand Trunk Ry. some years ago, has been appointed chief engineer of the Anticosti Corporation to deal with the development of harbors and railways on Anticosti Island, Quebec.

T. H. DENNIS, who has been engineer in charge of highway maintenance in Division III for the California State Highway Commission, was recently made acting engineer of maintenance for the commission. Mr. Dennis entered the California State Highway Department in 1912 and has progressed through the positions of resident engineer, assistant engineer and principal assistant engineer.

NATHAN A. BOWERS, Pacific Coast editor of *Engineering News-Record*, was elected president of the San Francisco Engineers' Club at its recent annual meeting. The other officers elected are: E. M. BREED, of the Pelton Water Wheel Co., vice-president; G. R. KINGSLAND, of the Otis Elevator Co., secretary; and A. D. OLIVER, of Wells Fargo Bank and Union Trust Co., treasurer.

HAROLD W. HORNE has been appointed engineer in charge of the Ware-Wachusett tunnel to be built by the Metropolitan District Water Supply Commission of Massachusetts. Mr. Horne has previously been connected with the Metropolitan Board, of Boston, the Board of Water Supply of the city of New York, the water-works of Hartford, Conn., and the Miami Conservancy District, in Ohio.

SAM K. PIERCE, vice-president, has been put in charge of the recently opened office of the John W. Cowper Co., Inc., at Atlanta, Ga. The company has offices in Buffalo and New York City. The Atlanta office is in the Healy Building.

H. MURRAY JACOBY is president and V. BERNARD SIEMS is vice-president and general manager of a new water company, the North American Water Works Corporation, which has been formed by representatives of industrial, fire insurance and public utility interests and which will negotiate to purchase a group of utilities in the South. Mr. Jacoby is head of H. M. Jacoby & Co. and has resigned as chairman of the Associated Public Utilities Corporation to assume the presidency of the new company. Mr. Siems has resigned as president of the Baltimore, Md., Water Board and chief water engineer of Baltimore.

JOHN F. VAUGHAN, consulting engineer, Boston, has been appointed chairman of the Hydraulic Power Bureau of the Engineering Section of the New England Division, National Electric Light Association, succeeding W. D. Henderson, resigned.

Obituary

JAMES EWING, president of the Town Planning Institute, of Canada, died at his home in Montreal Nov. 5 after a very short illness. He was 63 years of age. Mr. Ewing was born in Scotland, where he received his engineering education. Going to Canada in 1885 he entered the service of the Canadian Pacific Ry. as a draftsman, later becoming chief draftsman in the construction department. After 29 years of service with the Canadian Pacific, Mr. Ewing established the engineering firm of Ewing, Lovelace & Tremblay, later Ewing & Tremblay, Montreal. During the last twelve years he gave his time and energy to the advocacy of comprehensive town planning for the city and district of Montreal, and he prepared the plan for a new city on the south shore of the St. Lawrence River embracing several of the suburban municipalities of Montreal.

D. Y. JOHNSON, Memphis, Tenn., a stone contractor and also a building constructor, and president of the D. Y. Johnson Stone Co., died Oct. 30.

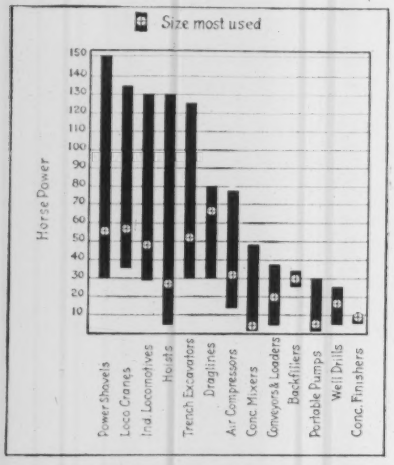
Construction Equipment and Materials

A SECTION DEVOTED TO WHAT THE MANUFACTURER IS DOING FOR THE ENGINEER AND CONTRACTOR

Gas Engine Survey Shows Power Trends

On Construction Equipment, Gasoline Power Leads Steam and Electricity—57,300 Units Sold Annually

A SURVEY of the character and extent of use of gasoline engines and their accessory equipment recently completed by the market survey department of *Engineering News-Record* estimates the annual purchases of gasoline engines for operating construction machinery as 57,300 units in sizes from 1½ to 150 hp. The figure for total number of units does not include stationary engines for water-works and sewage



Hp. Range and Average for Gasoline Engines on Construction Machines

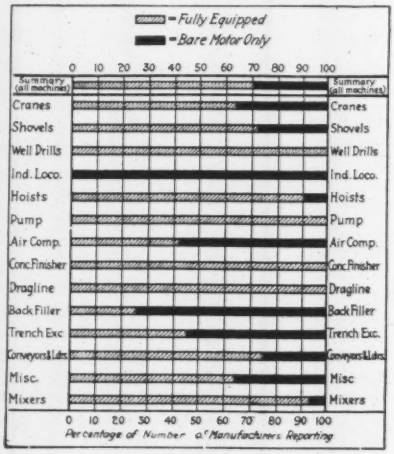
pumping plants, irrigation service, movable bridges, etc., nor for motor trucks and tractors. The estimated total hp. sold annually is placed at 1,002,750.

The survey further indicated that in recent years a marked change has taken place in the trend of power requirements for construction service. The use of steam has diminished, while gasoline power and electric power have made noteworthy gains. Accessory equipment such as carburetors, magnetos, spark plugs, air filters, radiators, governors, etc., was found by the survey to be commanding attention. Both construction equipment manufacturers and contractors are becoming more discriminating in their choice of accessories. The following information represents extracts from the report made as a result of the survey.

Trend of Power Requirements Has Changed—Within the past decade a revolution has occurred in practice affecting power for engineering-construction operations. It is necessary to go back only about a dozen years to find the steam engine holding undisputed sway in the construction field. Electric power was beginning to make headway, particularly on jobs within city limits where current could be readily delivered, but the internal combustion engine was rarely encountered. The early gasoline engines were one-cylinder machines equipped with hit-and-miss ignition systems and with large flywheels, manifestly unsuited for the character of industrial work they were called upon to perform. They now have been superseded by improved multiple-cylinder units using the four-cycle principle, designed especially for industrial use.

Even on comparatively light equipment the construction man is demanding a multiple-cylinder gasoline power unit. Single-cylinder engines are limited to the machines of comparatively small size, from 1 to 10 hp. Two-cylinder engines, most common in sizes from 3 to 12 hp., are used on light-duty machines, but for heavy duty the greatest demand is for four-cylinder gasoline units from 15 to 150 hp. and upward with indications that the six-cylinder or even the eight-cylinder unit may occupy a position of importance in this field in the not distant future.

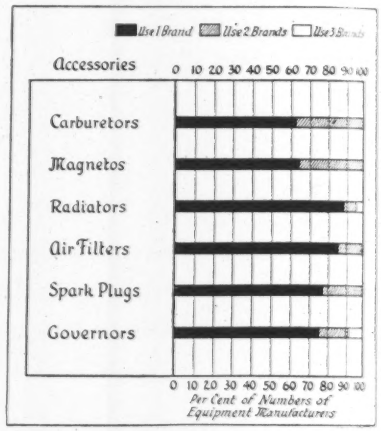
While some contractors prefer steam-operated plant for certain construction conditions, the general trend is away from this form of power and toward the internal combustion engine and the electric motor. Another recent survey by *Engineering News-Record* indicated that the construction industry uses 928,000 hp. in 37,000 electric motors ranging in size from ¼ to 1,600 hp., the average size being about 25 hp. It, however, is well within the fact to state that of all the construction equipment in service today, by far the largest majority operates on gasoline engine power. Very recent indications point to active competition by the Diesel type of engine in the construction equipment



How Equipment Manufacturers Buy Gasoline Engines

field and a number of the leading manufacturers of power shovels, draglines, and cranes are now prepared to furnish such engines as standard power equipment.

Merchandising Practices—Construction equipment manufacturers, as a rule, do not build their own gasoline engines, but purchase these units from the companies engaged exclusively in engine manufacture, governing the number, type and size of the engines they install in their machines by the demands of the contractors and engineers who constitute the purchasers and users of their products.



Accessory Brand Standardization Practice, Gasoline Engines

While many equipment manufacturers endeavor to standardize on one make of gasoline engine for their machines this practice is by no means universal. Where construction machines, such as industrial locomotives or compressors, are made in different sizes or capacities, two or sometimes more different makes of gasoline engine are bought and installed as the power plants. Even for machines of one size the equipment manufacturer does not always use only one make of gasoline engine; he may select the power units of any one of several engine manufacturers, depending upon the preference of the contractor or engineer who is his customer.

Engine Speeds—For the operation of construction equipment a slower-speed gasoline engine is needed than for an automobile or motor truck. Heavy-duty excavating and material-handling machines use speed ranges from 800 to 1,200 r.p.m. Speeds of hoisting engines (4-cylinder) run from 1,000 to 1,200 r.p.m. Air-compressor engine speeds from 800 to 1,000 r.p.m. are common. For the large size concrete mixers the engine speeds range from 1,000 to 1,200, while for the smaller mixers engine speeds of 600 r.p.m. are common with one-cylinder engines. Portable trench pumps use engine speeds of about 600 r.p.m.

Gasoline Engine Accessory Equipment—A gasoline engine, ready for operation, consists of the bare motor and a number of essential accessories, including carburetors, magnetos, radiators, air filters, spark plugs and gov-

engines. The survey included an investigation of each type of accessory equipment but only a few general notes will be given here.

Gasoline engine accessories are sold to two groups: (1) The gasoline engine manufacturers, and (2) the construction equipment manufacturers who buy their engines unequipped. The same merchandising practices as given above for gasoline engines apply to accessory equipment. The amount of this equipment used and the manufacturer who supplies it will be determined by the preferences which contractors and engineers develop.

Continuous operation, guaranteed by a good gasoline engine with dependable accessories assumes a far larger significance in the case of a construction machine than for a passenger automobile or motor truck. The construction machine is the master link in a long chain of mechanical and hand-labor operations involving the transportation and placing of materials. If the key machine stops because there is some trouble with carburetor or ignition, other machines and men in the train of operations remain idle until the trouble is remedied. The overhead cost of idle men and idle machines, even though the periods of shutdown be short, mounts into figures that, in the aggregate, may mean the difference between profit and loss on the job. Delays due to engine trouble on an automobile or truck, on the other hand, involve usually only the occupants of that one vehicle.

As to their general type, construction machines have been standard for many years. The trend of present day progress is along definite lines of improvement in details and accessories.

Protests Made Against Cement Imports

Not only the cement manufacturing industry, but also practically the entire range of American industry is affected by the losses incurred through the use of foreign made cement, according to a statement made by H. Struckmann, president, International Cement Corporation, New York City. He asserts that the consumption of 10,000,000 barrels of foreign-made cement in this country since 1920 has resulted in a loss of $29,000,000 to American industry, the greatest bulk of which is charged to the cement industry with $16,000,000, the largest single item of which is wages; the coal industry with $1,462,500; the power companies with $1,700,000; and the railroads with $7,182,400.

Cheap labor and low fuel cost enable the foreign manufacturer to manufacture cement which will sell in this country from 15 to 30 cents per barrel under the American made product. Belgium manufactures approximately 50 per cent of the total quantity of imported cement. Skilled labor in Belgium receives 90 cents per day; American cement mill labor is paid $4.50 per day. Mr. Struckmann states that while many believe that the purchase of foreign cement is an indirect method of helping Europe to get back on its feet, that it is important to understand that we cannot help Europe by hurting American business.

"Europe is producing more cement and other heavy commodities than she did before the war," says Mr. Struckmann, "but her ability to buy them herself is considerably diminished. As long as that condition continues, this menace to American business will remain with us. America must wake up or find her own prosperity seriously impaired."

City Officials See Exhibits of Equipment and Materials

At the convention of the American Society for Municipal Improvements held in Washington, D. C., November 8-12 at the Mayflower Hotel, a large room was devoted to exhibits of equipment and materials for use in municipal engineering and construction. The meetings at the same place of the Asphalt Association convention swelled the total attendance to something over 700 city officials and paving engineers and contractors. The following manufacturers had exhibits at the convention:

National Paving Brick Manufacturers Association.
W. & L. E. Gurley.
Hadfield-Springfield Roller Co.
The Foote Co.
Hastings Pavement Co.
Portland Cement Association.
Barber-Greene Co.
Koehring Co.
Chas. Hvass & Co.
Atlas Lumnite Cement Co.
American Vibrolithic Co.
Black & Decker Mfg. Co.
Good Roads Equipment Corp.
Lock-Joint Pipe Co.
Warren Brothers Co.
Elgin Sales Corp.
Presstite Engineering Co.
Kentucky Rock Asphalt Co.
Celite Products Co.
Blaw-Knox Co.

Mixer Manufacturers Adopt 10-E Paver as Standard

At the eighth meeting since its organization as one of the affiliated bureaus of the A.G.C. the Mixer Manufacturers Bureau adopted as standard the 10-E paving mixer. It had been felt for some time that a mixer slightly larger than the 7-E (which has a capacity of a 2 bag mix of 1:1½:3½) was needed for such work as sidewalk, curb and gutter, and alley work. The 10-E machine is the result. It has a capacity of 2 bags, 1:2½:4. The resolution adopting the 10-E machine eliminated the 7-E paver as a standard.

The Bureau now has fifteen members as listed below, the last two only recently having been admitted to membership.

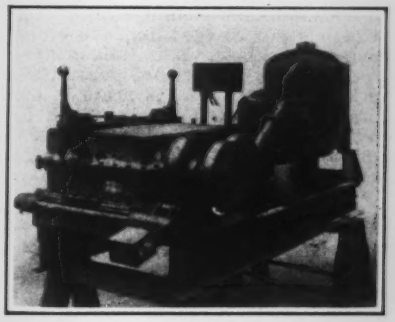
American Cement Machine Co., Keokuk, Ia.
Archer Iron Works, Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Construction Machinery Co., Waterloo, Ia.
Jaeger Machine Co., Columbus, Ohio.
Knickerbocker Co., Jackson, Michigan.
Koehring Co., Milwaukee, Wis.
Kwik-Mix Concrete Mixer Co., Port Washington, Wis.
Lakewood Engineering Co., Cleveland, Ohio.
Marsh-Capron Co., Chicago, Ill.
Ransome Concrete Machinery Co., Dunellen, N. J.
Remmel Mfg. Co., Kewaskum, Wis.
T. L. Smith Co., Milwaukee, Wis.
Orr & Sembower, Inc., Reading, Pa.
Standard Scale and Supply Co., Pittsburgh.

New Developments

Compact Gasoline Engine Unit for Bridge Operation

A power unit to be used either as a prime mover or for stand-by purposes in the operation of movable bridges, lock gates, large valves and similar machinery, has been developed by the Earle Gear & Machine Co., Philadelphia, Pa. The unit, as illustrated, consists of a standard make of gasoline engine fitted with accessories such as radiator, magneto, starter, generator, storage battery, disk clutch, etc., together with a special gear box, the whole mounted on a structural steel frame. The unit is built in various sizes from 15 to 100 hp. and weighs from 2,000 lb. for the smallest size to 3,500 lb. for the largest.

The gear box is claimed to have many advantages over the use of chains, sprockets, friction clutches, etc., which are often used in the operation of movable bridges. The unit is completely inclosed and therefore self-lubricated. A gray iron casting is used for the housing of the gear box and is accurately machined and oiltight. The gears are of alloy forged steel with cut teeth and all bearings are lined with anti-friction metal and are renewable.



Power take-offs can be arranged to provide one or two reversible shafts either at right angles to the center line or parallel to the center line of the engine. The speed of the take-offs is from 300 to 500 r.p.m.

A foot pedal is provided to facilitate accurate control of the movement of the bridge or other machinery. In addition to this, an interlocking device can be provided to prevent the non-movement of the bridge until wedges are drawn, signals set, etc.

A New 1¼-Yd. Gasoline and Electric Shovel

Following the successful use of its 1-yd. gasoline and electric shovel, the Osgood Co., Marion, Ohio, has designed a 1¼-yd. shovel of similar specifications. The machine is convertible to a crane by change of boom. It is built almost entirely of open-hearth and alloy steel castings and little cast iron or structural steel enters into its construction. Four friction clutches of the outside contracting band type are used in the usual operation of the machine. Plain

spur gears are used, all upper body gears having teeth machine cut from the solid.

An inclosed gear drive continuous tread truck is standard equipment; all gears run in heavy oil. A wire rope mechanism is used for the crowding motion and is self-adjusting to all boom angles. Among the other features are manganese front dipper, combination oak and steel boom and handle, special Osgood 6-cylinder gasoline engine in-

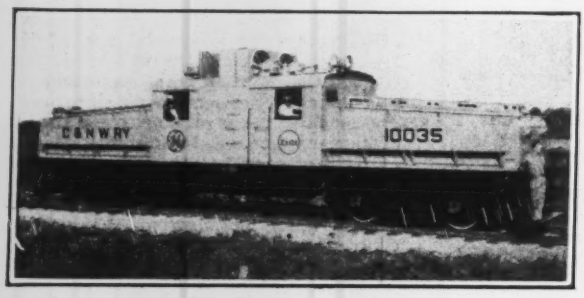
cluding a self-starter, an all-steel house with closed front and a combination gasoline tank and counterweight. The latter is made of cast iron, the center being made hollow. It is built into the upper body as an integral part of the machine. The casting is made in one piece with very thick walls which insures freedom from leakage and also from the possibility of catching fire. The capacity of the tank is 75 gal.

Storage Battery Locomotive With Gas-Electric Auxiliary

What is claimed to be the largest storage battery locomotive in the world has been delivered by the General Electric Co., Schenectady, N. Y., to the Chicago & Northwestern Railway Co. at Chicago. A gas-electric auxiliary drive is provided which can be used either to propel the locomotive or to charge the storage battery; however under ordinary circumstances it will be charged by special equipment installed in the freight yards. It is intended that the storage battery will usually be used as the source of power for the traction motors. The machine will be used for switching service at Chicago.

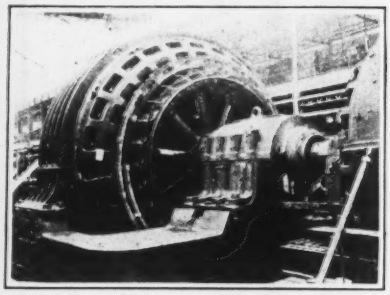
The storage battery is made up of 120 cells with a capacity of 616 kw.-hr. These storage batteries can deliver 1,000 hp. to the driving motors, which is claimed to be greater than for any other type of self-propelled locomotive of equal weight. The gasoline engine is a Winton model 106-A. It is a 6-cylinder, 1,000-r.p.m. unit with 7¼x8-in. cylinders. The generator is a G.E. type DT-508-A shunt-wound machine designed to supply 230 volts. A 150-gal. fuel tank is suspended underneath the platform. Gasoline is fed to the carburetor by a magnetically operated diaphragm pump. Each of the four axles carries a motor driving through a single reduction gear.

The overall length is 52 ft., wheel base, 39 ft., height, 14 ft., width 10 ft. Tractive effort on 1-hr. capacity is 17,200 lb. with a speed at 1-hr. rating of 9½ m.p.h. Maximum speed of 30 m.p.h. is claimed. Locomotives of a similar type but smaller have been in successful operation for several years in industrial plants.



An 8,000-Hp. D.-C. Motor

A motor which has recently been shipped from the Westinghouse Electric & Mfg. Co.'s plant at East Pittsburgh, Pa., has a rating of 8,000 hp. and weighs 625,000 lb. It is claimed to be the world's largest d.c. motor. Overall length of the shaft is 26 ft. 8 in. and the frame has an outside diameter of 20 ft. The motor obtains its power from a flywheel set which consists of

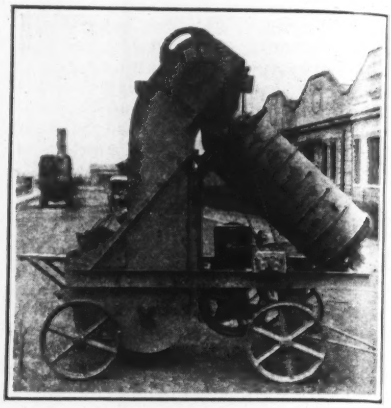


two 3,500 kw., 700 volt generators operating at 375 r.p.m. Three 50,000 lb. flywheels are used to equalize the peak loads.

A Continuous Batcher Mixer of English Construction

Something entirely different from the conventional type of concrete mixer used in this country is being introduced by Concrete Equipment, Ltd., 4-6 Starroad, West Kensington, London, England, in the form of a continuous batch mixer. The cement, sand and aggregate are accurately measured mechanically by means of three separate systems of buckets operating on endless chains. These bucket chains pick up the materials from their separate hoppers at the bottom of the mixer of the machine, elevate them to the top and deliver directly to the mixing drum. The buckets pass beneath a scraper which keeps their contents flush with the top. The correct amount of water is introduced into the drum simultaneously with the material.

The drum is cylindrical about 4 ft. long fitted with a patented system of baffle plates, dividing it into six compartments. Each batch passes through these in succession, and is finally delivered in an uninterrupted flow. The small quantity

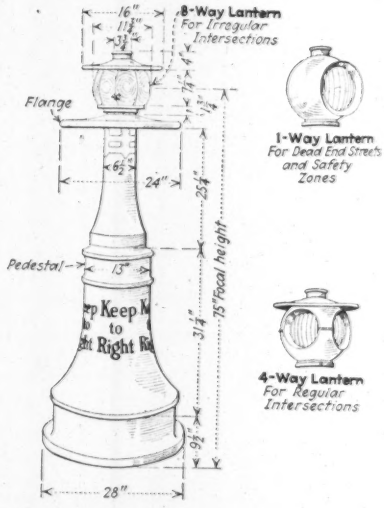


dealt with at any one time, 2.55 cu.ft., is said to insure a perfect mix.

The machine is fitted with three speeds, and has a capacity of 6, 12, or 18 cu.yd. per hr. A 3½-hp. Lister engine is used for power. It is said that the labor force required to operate the mixer varies from 2 to 4 unskilled men.

A Pedestal Traffic Signal

Made of semi-steel or gray iron, weighing approximately 750 lb., the traffic signal illustrated is of the pedestal type being fitted for three interchangeable lanterns. The signal is cast in three pieces, the bottom section being fitted with a base and anchor lugs cast inside to hold and securely fasten the acetylene gas tank in the proper position: there are also four lugs which take anchor bolts. The top section is flanged at the top and bolts to the bottom section. The third casting is the door.



The size of the pedestal is claimed to be ample for placing directional signs and traffic wording, and sufficient to hold an acetylene supply capable of automatic operation for a continuous period of at least 75 days. The signal is painted white with black trim unless otherwise specified.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Present High Level of Construction Cost Due Mostly to Labor

Materials Represent but Slightly More than 47 per Cent of Total Cost—Situation of 1920 Reversed

THE object of the comparisons made in the accompanying illustration is primarily to show that cost of labor is responsible for the fact that since 1923, total cost of construction (labor plus materials) has broken away from materials cost levels and traveled along on a higher plane up to the present time. Previous to 1923, this divergence did not occur. In the 1919-1920 inflationary period, cost of materials was above that of labor in most instances. Comparisons are with 1913 as 100.

Labor costs represent nearly 53 per cent of total construction cost in the current market. All figures in the chart are from the Bureau of Labor Statistics except the *E. N.-R.* Construction Cost Index Number which, since 1924, has pursued a course about midway between labor and materials' costs.

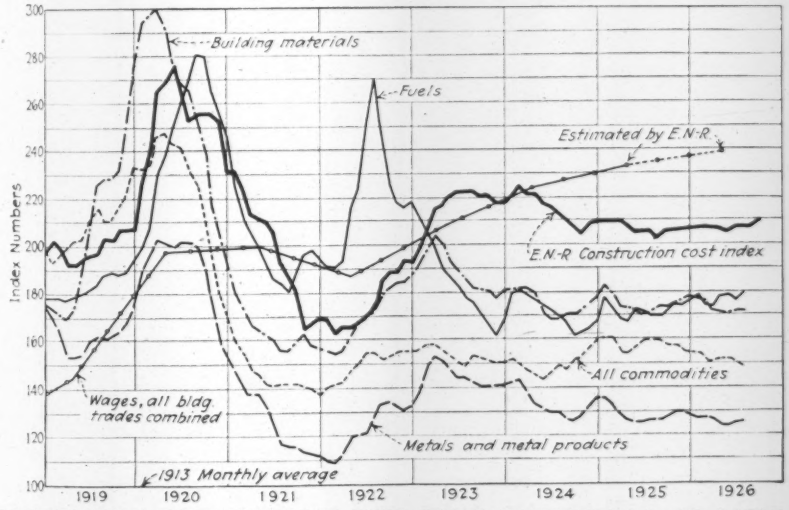
Prices of commodities in general are not working to lower levels but seem instead to have hovered between 40 and 60 per cent above the 1913 level, since 1922, the year in which the present building boom began.

Equally high production and consumption rates have accompanied this price movement. Production in the basic industries has run from 6 to 25 per cent above the 1919 level, since the fall of 1924.

Consumption of goods is indicated by revenue freight movements. Weekly car loadings have been heavier since January, this year, than for the corresponding periods in other years, except one week in 1923, three in 1924 and two in 1925.

The high production rate has prevented price advances above the levels stated, by eliminating scarcity. The high consumption rate has rendered accumulations of heavy reserve stocks difficult. The policy for the last few years has been to purchase for immediate needs only, thus insuring a close relationship between output and demand.

All of the various materials shown in the chart will probably develop slight seasonal upturns in prices during the next month or so.



CONSTRUCTION COSTS COMPARED WITH THOSE OF MATERIALS AND LABOR

Cement Imports Gaining—Exports on Decline

At the present rate of increase 1926 importations of portland cement will exceed those of last year by about 1.3 per cent, according to latest figures submitted by the Bureau of Foreign and Domestic Commerce.

Exports of the same material will probably show a drop of approximately 3.4 per cent.

For the first nine months of this year imports totaled 2,779,570 bbl., against 2,436,120 for the same period in 1925. Exports for the first three-quarters of 1926 amounted to 738,263 bbl., compared with 744,080 in the corresponding months last year.

About 88 per cent of present cement imports come from Belgium, against 38 per cent a year ago. Canada, Denmark, Faroe Islands, and the United Kingdom are jointly supplying the other 12 per cent. A year ago eleven nations were sending cement to the United States.

This Week's Contracts—Week Ago—Same Week Last Year

The money value of contracts reported in the present issue of *Engineering News-Record* is here compared with the figures for corresponding weeks. Minimum costs observed are: $15,000 for water-works and excavations; $25,000 for other public works; $40,000 for industrial and $150,000 for commercial, educational, religious and other buildings. Under the head of excavations are included drainage, irrigation, levee, river and harbor projects.

MONEY VALUE OF CONTRACTS LET—ENTIRE U. S.

Week Ending	Public Work	Private Work	Total Contracts
Nov. 18, 1926	$19,264,000	$36,814,000	$56,078,000
Nov. 11, 1926	14,843,000	54,965,000	69,808,000
Nov. 19, 1925	12,327,000	31,523,000	43,850,000
Heaviest Week			
1926, Mar. 11	13,029,000	73,613,000	86,642,000
1925, Sept. 3	16,215,000	69,424,000	85,639,000
January 1 to date			
	Public	Private	Total
1926	$981,481,000	$1,612,362,000	$2,593,843,000
1925	948,522,000	1,324,608,000	2,273,130,000

Special Tabulation of Unit Prices

Timber Piling

The following unit prices are included in the low bidders' estimates on various projects, 1922 to date:

Location	Date	Lin. Ft.	Price per Lin. Ft.
Subway, Flushing, N. Y.	Oct., 1922	15,000	$0.55
Shop foundation, New York, N. Y.	Oct., 1922	150,000	.42
Bridge, Jefferson Co., Wash.	Oct., 1922	4,000	.50
Sewer, Matawan, N. J.	Mar., 1923	100	1.25
Bridge, Astoria, Me.	April, 1923	14,900	.52
Sewer, Toledo, O.	April, 1923	1,500	1.00
N. Y.-N. J. Hudson River Tunnel	June, 1923	100	1.50
Dikes, near St. Charles, Mo.	June, 1923	417,726	.51
Bridge, Haverhill, Mass.	June, 1923	16,000	.60½
Bridge, Charleston, S. C.	Aug., 1923	7,200	.95
Bridge, Dumbarton Straits, Calif.	Oct., 1923	140,000	.29
Bridge, Perth Amboy, N. J.	Nov., 1923	98,998	1.59
Sewer, Chicago, Ill.	Nov., 1923	2,000	1.10
Subway, Brooklyn, N. Y.	Dec., 1923	100	1.00
Conduit, Brooklyn, N. Y.	Feb., 1924	1,000	1.00
Bridge, Springfield, Mass.	Mar., 1924	29,000	.70
Bridge, Harrisburg, Ore.	May, 1924	22,000	.70
Intake, Denver, Colo.	June, 1924	5,500	2.67
Sewer, Philadelphia, Pa.	June, 1924	7,300	.75
Highway, Delaware, State	June, 1924	1,200	1.75
Sewer, St. Louis, Mo.	July, 1924	6,370	1.25
Grade separation, Detroit, Mich.	Oct., 1924	24,300	.70
Conduit, Brooklyn, N. Y.	Jan., 1925 / Feb., 1925	500 / 1,000	.50 / 1.00
N. Y.-N. J. Hudson River Tunnel	April, 1925	17,500	2.00
Bridge, Detroit, Mich.	July, 1925	62,800	.70
Bridge, Broadkill Creek, Del.	Feb., 1926	3,300	.80
Viaduct, Jersey City, N. J.	Mar., 1926	75,980	.65
Bridge, Chicago, Ill.	May, 1926	14,110.80 @	.90

Weekly Construction Market

THE present slight downward turn in prices of basic construction materials is evidently purely seasonal. No price advances of importance occurred during the week. Steel and brick held firmly to levels maintained throughout the last month in the principal cities.

Lumber and materials other than brick and steel, are mainly responsible for the weakness in the general price situation.

June is the only month thus far this year in which steel has shown any marked tendency toward price softening. Lumber, on the other hand, has been consistently depressed since February, 1926. This is probably accounted for by the fact that construction other than residential, Jan. 1 to date, is from 11 to 14 per cent ahead of the corresponding period in 1925, while residential building shows a deficit. Cement prices maintained even greater steadiness than steel.

Concerning the underlying factors in the steel market it is found that a better demand for pig iron exists in the Southern districts, while prices are firmer at Pittsburgh. The small volume of iron inquiries in the New York market indicate that higher fuel costs have not induced widespread buying to cover further advances in price.

Scrap continues dull and demand is slow for steel bars, strips and automotive material. Most of the slowing down in buying is seasonal and steel rails are evidently the only really active material in the market.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products									
Structural shapes, 100 lb.	$3.34	$3.80	$4.15	$3.10	$3.35	$3.07½	$3.30	—3.15	$3.75
Structural rivets, 100 lb.	4.20	3.80	4.75	3.50	3.75	4.65	5.00	4.00	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.24	2.80	3.38	2.60	2.87½	3.77½	2.95	—3.10	2.50
Steel pipe, black, 2½ to 6 in. lap, discount	48%	54%	53.6%	51%	54.25%	41%	49.7@54.1%	45%	37.83
Cast-iron pipe, 6 in. and over, ton	51.60@52.60	45.25	54.00	48.20	53.00	64.00	50.00	55.00	55.00
Concreting Material									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	2.32	2.85	2.31	2.65	1.15
Gravel, ¾ in., cu.yd	1.75	1.90	2.38	1.85	1.65	1.90	1.80	—1.25	1.50
Sand, cu.yd.	1.00	1.60	2.00	1.65	1.25	1.00	1.40	—1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.94	2.50	2.83	1.87½	1.75	2.50	1.70	3.00	2.00
Miscellaneous									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62.00	34.00	56.00	40.50	38.75	34.75	27.00	+25.00	—50.00
Lime, finishing, hydrated, ton	18.20	+23.50	19.00	20.00	25.50	24.00	25.50	24.00	21.00
Lime, common, lump, per bbl.	2.10@3.00	+1.50	1.82	1.50	1.70	2.70	1.60	2.80	10.00
Common brick, delivered, 1,000	20.40@22.40	—10.50	14.10	12.00	13.75	9@10	15.00	15.00	20.25
Hollow building tile, 4x12x12, per block	Not used	.0895	.112	.088	.076	.075	.....	.09	.10
Hollow partition tile 4x12x12, per block	.1027	.0895	.112	.088	.076	.075	.108	.09	.08
Linseed oil, raw, 5 bbl. lots, per 7½-lb. gal.	+ 86¼	.99¾	1.10	.85	.93¾	+1.07	1.01	1.12	1.05
Common Labor									
Common labor, union, hour	.90⅝	.30	.....	90	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	.....	.25	.30@.50	.82½	.45@.60	.40@.45	.50	.50	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent. L.c.l. is less than carload lots.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime in 280-lb. bbl. net and hydrated lime, f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Reinforcing bars (billet steel) and shapes delivered to job in less-than-carload lots.

Labor — Cement and concrete laborers' rate, $1.06¼; building laborers, 90⅝c.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber, sand, gravel and stone f.o.b.; price on fir is quoted instead of pine. Reinforcing bars (billet steel) f.o.b. warehouse in carload lots; shapes, less-than-carload lots.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. Bars (billet steel) at warehouse in carload lots; shapes, less-than-carload lots.

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Nov. 4 the next on Dec. 2.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered in wooden bbl. Common lump lime per 180-lb. net. Bars (billet steel) and shapes, l.c.l.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Dallas quotes lime per 180-lb. bbl. Cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered. Bars (billet steel) and shapes, l.c.l.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C.-I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common. Bars (billet steel) f.o.b. in carload lots; shapes, l.c.l.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Brick and hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers. Bars (billet steel) and shapes, less-than-carload lots.

Montreal quotes on fir lumber. Sand, stone, gravel and lump lime per ton. Stone and tile are delivered; sand, gravel, lime and cement on siding; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 100.156). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½ in., $37.83. Bars (billet steel) carload lots; shapes, l.c.l.

Business Briefs

Call money quoted at 5 per cent, Nov. 16; year ago, 5 per cent.

Time loans: 60 to 90 days, 4⅝@4¾; 4 to 6 months, 4⅝@4¾ per cent.

Commercial paper: Best names, 4@6 mo., 4½; others, 4¾ per cent.

On Nov. 1, 1926

E. N.-R. Construction Cost Index Number 210.80

E. N.-R. Construction Volume Index Number 244

For Explanation and Details of Indexes Since 1913 See the First Issue of Every Month